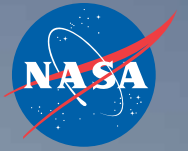


National Aeronautics and
Space Administration



Launching the Future

Kennedy Space Center's
ANNUAL REPORT FY13

The refurbished crawlerway that leads from Kennedy's iconic Vehicle Assembly Building to Launch Pads 39A and 39B will serve as the pathway to the pads for NASA's Space Launch System and a variety of other launch vehicles.



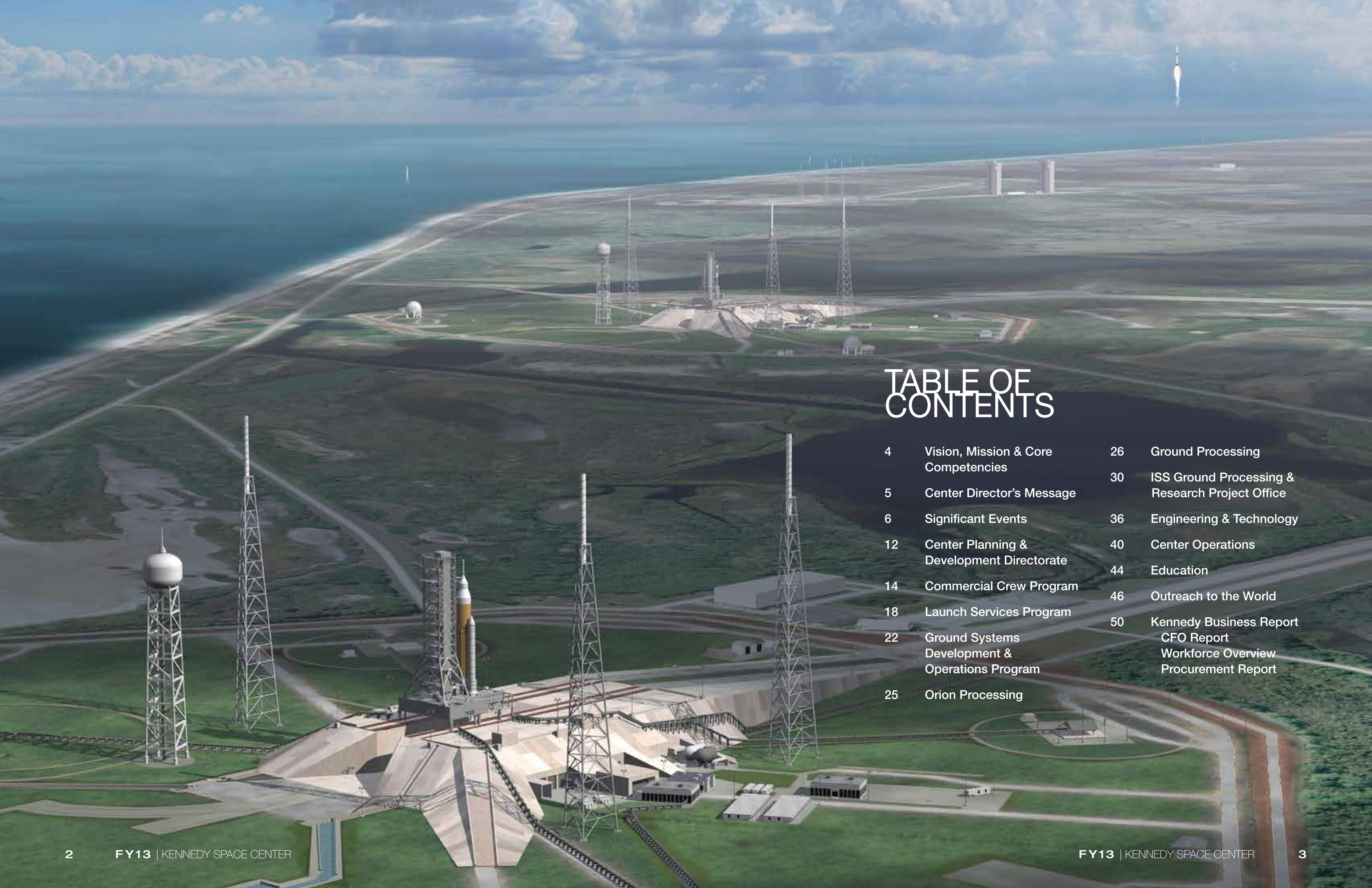


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VISION, MISSION & CORE COMPETENCIES

KSC Vision

KSC is the world's preeminent launch complex for government and commercial space access, enabling the world to explore and work in space.

KSC Mission

KSC safely manages, develops, integrates and sustains space systems through partnerships that enable innovative, diverse access to space and inspires the nation's future explorers.

KSC Core Competencies

- Acquisition and management of launch services and commercial crew development
- Launch vehicle and spacecraft processing, launching, landing and recovery, operations and sustaining
- Payload and flight science experiment processing, integration and testing
- Designing, developing, operating, and sustaining flight and ground systems, and supporting infrastructure
- Development, test and demonstration of advanced flight systems and transformational technologies to advance exploration and space systems

CENTER DIRECTOR'S MESSAGE



Robert D. Cabana
Center Director

It was an exciting and productive time at Kennedy Space Center during Fiscal Year 2013 as we continued to transition from a historically government-only launch facility to an affordable, flexible, multi-user spaceport for both government and commercial customers.

Four primary missions were managed and successfully launched by the Launch Services Program from both U.S. coasts: the Tracking and Data Relay Satellite-K, Landsat Data Continuity Mission, Interface Region Imaging Spectrograph and Mars Atmosphere and Volatile Evolution. In addition, 16 CubeSats, or very tiny satellites, were sent aloft as secondary payloads aboard an expendable launch vehicle as part of NASA's Educational Launch of Nanosatellite mission.

During the year, the Ground Systems Development and Operations Program completed 20 projects in the Launch Complex 39 area, including major modifications to Launch Pad 39B, the Vehicle Assembly Building, the Mobile Launcher, and the crawler-transporter. The work moved the center closer to being ready to support processing and launch of NASA's Space Launch System and Orion spacecraft in FY 2018.

Building on its processing expertise, the International Space Station Ground Processing and Research Project Office supported the integration of two orbital replacement units for the space station. More than ten science labs in the Space Station Processing Facility also were outfitted to support the SpaceX-2 resupply mission to the space station. These labs will continue to be available to support future payload developers.

The Commercial Crew Program met several milestones working with commercial partners to develop the next generation of American-made spacecraft that will launch our astronauts from U.S. soil to the space station and safely return them home.

Space shuttle Atlantis has a new home inside the newly constructed Atlantis facility at the Kennedy Space Center Visitor Complex. Atlantis, along with a full-scale replica of the Hubble Space Telescope, International Space Station displays and space program artifacts, will continue to tell the U.S. space program story to thousands of people for many years to come.

We made tremendous progress transforming Kennedy this year. As challenging and exciting as it was, 2014 will be even more so as we continue to implement the goals we've set for our future.

1. **October 2012: Surface Repairs Begin at Launch Pad 39B**

Upgrades to the surface of Launch Pad B began with the removal of the crawler track panels in order to repair the concrete surface and the catacomb roof below the pad. Pad B is being upgraded so that it is ready to support the launch of NASA's Space Launch System and Orion spacecraft in Fiscal Year 2018.

2. **Oct. 1-5, 2012: Boeing Performs Air Bag Stabilization Testing**

The Boeing Company's mock-up CST-100 spacecraft was put through water landing development tests at Bigelow Aerospace's headquarters outside of Las Vegas. The tests were part of Boeing's ongoing work under its Commercial Crew Integrated Capability (CCiCap) agreement with NASA's Commercial Crew Program (CCP).



3. **Oct. 4, 2012: Blue Origin Completes Rocket Engine Thrust Test**

Blue Origin successfully fired the thrust chamber assembly for its new 100,000-pound-thrust liquid oxygen, liquid hydrogen engine. As part of the company's Commercial Crew Development Round 2 (CCDev2) with CCP, the engines are designed eventually to launch its biconic-shaped Space Vehicle.

4. **Oct. 7, 2012: First SpaceX Resupply Mission**

A Space Exploration Technologies Corp. (SpaceX) Falcon 9 rocket carrying its Dragon spacecraft lifted off from Cape Canaveral Air Force Station (CCAFS) at 8:35 a.m. EDT on NASA's first cargo delivery flight, designated CRS-1, to the International Space Station.



5. **Oct. 15, 2012: United Launch Alliance Completes Space Act Agreement**

United Launch Alliance (ULA) announced the completion of its CCDev2 partnership with CCP, laying the foundation for potentially certifying its Atlas V rocket for crewed missions.

6. **Oct. 16, 2012: Industry Day and Expo**

Kennedy Space Center hosted the Historically Underutilized Business Zone, or HUBZone, Industry Day and Expo 2012, for business leaders interested in learning about government contracting opportunities and what local and national vendors have to offer.

7. **Oct. 17, 2012: Atlantis' Final Move to the Vehicle Assembly Building**

Space shuttle Atlantis moved from Orbiter Processing Facility-2 to the Vehicle Assembly Building for the final time. Atlantis was being prepared for its move to the Kennedy Space Center Visitor Complex.



8. **Oct. 19, 2012: Blue Origin Completes Pad Escape Test**

Blue Origin conducted a successful pad escape test at the company's West Texas launch site, firing its pusher-escape motor and launching a full-scale suborbital crew capsule from a simulated propulsion module. The test was part of Blue Origin's work supporting its CCDev2 agreement with CCP.

9. **Nov. 1, 2012: Orion Crew Module Undergoes Pressure Test**

In a proof pressure test cell in the Operations and Checkout Building, the Orion Crew Module underwent a pressure test to demonstrate weld strength capability and structural performance at maximum flight operating pressures.



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- 10. Nov. 1, 2012: SpaceX Completes Performance Milestones**
SpaceX announced the completion of its first three performance milestones under its CCIcap agreement with CCP. The milestones included a financial investment review, ground operations plans and technical reviews of the company's spacecraft and rocket combination.
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- 11. Nov. 2, 2012: Atlantis Moves to Kennedy Space Center Visitor Complex**
In the early morning hours, space shuttle Atlantis began its move from the Vehicle Assembly Building, stopping along its 10-mile trek for viewing by Kennedy workers, the media and the general public, before reaching its final destination.
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- 12. Nov. 8, 2012: ULA Selects Contractor for Pad Modifications**
ULA announced the selection of Hensel Phelps Construction Co. of Orlando, Fla., to begin outfitting Space Launch Complex 41 with the necessary systems and equipment to support crewed launches from Cape Canaveral Air Force Station in Florida. Hensel Phelps will provide program management contractor support as the company modifies the launch site in support of CCP. ULA's Atlas V rocket was selected to launch Boeing's CST-100 and Sierra Nevada Corporation (SNC) Space Systems' Dream Chaser spacecraft.
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- 13. Nov. 20, 2012: Crawler-Transporter 2 Takes Trip to Launch Pad 39A**
During two days in mid-November, crawler-transporter 2 was rolled out to Launch Pad 39A where it picked up the mobile launcher platform and then performed a series of maneuvers to test various functions, including how it handled the pad slope.
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- 14. Nov. 26-27, 2012: NASA Awards Liquid Hydrogen Contracts**
NASA selected Praxair Inc. of Danbury, Conn., and Air Products and Chemicals Inc. of Allentown, Pa., for follow-on contracts for the agencywide acquisition of liquid hydrogen.
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- 15. Dec. 10, 2012: Certification Next Step in Launching American Astronauts**
NASA announced the next step of its plans to launch American astronauts from U.S. soil and selected three companies to conduct activities under contracts that will enable future certification of commercial spacecraft as safe to carry humans to the International Space Station for CCP. The companies selected for the Certification Products Contract phase were Boeing, SNC and SpaceX.
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- 16. Dec. 12, 2012: GSDO Completes Important Reviews**
The Ground Systems Development and Operations Program (GSDO) at Kennedy completed an important Systems Requirements Review/System Definition Review and Preliminary Design Review as part of planning for future operations at the center.
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- 17. Dec. 17, 2012: TOSC Contract Awarded**
NASA awarded its Test and Operations Support Contract (TOSC) to Jacobs Technology Inc. of Tullahoma, Tenn. Work will be performed at Kennedy and Johnson Space Center in Houston.
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- 18. Dec. 18, 2012: TDRS-K Arrives at Kennedy**
NASA's newest Tracking and Data Relay Satellite, known as TDRS-K, arrived at Kennedy for final processing for launch.
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- 19. Dec. 21, 2012: Space Launch System Core Stage Passes Milestone**
NASA's Space Launch System core stage passed a preliminary design review at NASA's Marshall Space Flight Center in Huntsville, Ala.
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- 20. Jan. 2, 2013: KISS II Contract Awarded**
NASA awarded the Kennedy Space Center Institutional Support Services II (KISS II) contract to Wichita Tribal Enterprises LLC of Tulsa, Okla.
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21.	Jan. 30, 2013: TDRS-K Satellite Launches NASA's TDRS-K satellite launched aboard a ULA Atlas V rocket at 8:48 p.m. EST from Space Launch Complex 41 at CCAFS.	
22.	Feb. 1, 2013: NASA Day of Remembrance The Kennedy workforce paid tribute to the crews of Apollo 1 and space shuttles Challenger and Columbia, as well as other NASA colleagues, during the agency's Day of Remembrance at the Kennedy Space Center Visitor Complex. It was the tenth anniversary of the Columbia tragedy.	
23.	Feb. 11, 2013: New Earth-Observing Satellite Launches NASA's Landsat Data Continuity Mission (LDCM) roared into space aboard a ULA Atlas V rocket at 1:02 p.m. EST (10:02 a.m. PST) from Launch Complex 3 at Vandenberg Air Force Base (VAFB) in California.	
24.	Feb. 22, 2013: NASA Selects Launch Services for ICESat-2 Mission NASA's Launch Services Program at Kennedy selected United Launch Services LLC of Englewood, Colo., to provide Delta II launch services for the Ice, Cloud and Land Elevation Satellite-2 (ICESat-2) mission, currently scheduled for July 2016.	
25.	Feb. 27, 2013: Blue Origin Signs Unfunded Agreement for Additional Milestones Blue Origin signed an unfunded agreement with NASA to extend its CCDev2 partnership. The company will continue to advance the subsystems of its biconic-shaped spacecraft, putting emphasis on power and actuation systems, in-space propulsion, multiplex avionics and flight mechanics. The company also made progress on the spacecraft's guidance, navigation and control systems.	
26.	March 1, 2013: SpaceX Launches Second Resupply Mission SpaceX launched its Falcon 9 rocket and Dragon spacecraft at 10:10 a.m. EST from Space Launch Complex 40 at CCAFS on the second cargo resupply flight, designated SpaceX-2 to the International Space Station.	
27.	March 22, 2013: NASA Partners with Micro Aerospace Solutions NASA signed an agreement with Micro Aerospace Solutions of Melbourne, Fla., for use of an offline hardware processing "clean room" laboratory and office space in Kennedy's Space Station Processing Facility.	
28.	March 26, 2013: SNC Performs Ground Resonance Testing SNC put its Dream Chaser flight vehicle through a ground resonance test, standard testing for aircraft and helicopters to confirm that vibrations from machinery inside the craft won't make it shake itself apart. The Dream Chaser is under development in collaboration with CCP.	
29.	March 27, 2013: Upgrades Begin on Launch Pad 39B Flame Trench At pad B, construction workers began work to remove the legacy flame deflector located below and between the left and right pad surface crawlerway track panels. Apollo-era bricks from both walls of the flame trench also will be removed.	
30.	April 2-4, 2013: ISS Program Reviews Crewed Docking System NASA's International Space Station Program reviewed the docking system spacecraft could use for future missions to the space station, including the companies working with CCP. Plans call for the NASA Docking System (NDS) design to be made available to all U.S.-based, crew-carrying spacecraft docking with the station in the future. The docking system will be able to transfer power, data, commands, air and communications between the two craft as they orbit the Earth.	
31.	April 5, 2013: NASA Signs Agreement with PaR Systems NASA's Kennedy Space Center signed a new partnership agreement with PaR Systems Inc. of Shoreview, Minn., for use of the Hangar N facility and its unique nondestructive equipment.	

32. April 5, 2013: Boeing Completes Launch Vehicle Adapter Review

Boeing announced the successful completion of a preliminary design review of the component that would connect the company's new crew capsule to the ULA Atlas V rocket. The review was a performance milestone Boeing completed under its integrated capability agreement with CCP.

33. April 16, 2013: NASA's Newest Solar Satellite Arrives at VAFB

NASA's Interface Region Imaging Spectrograph (IRIS) satellite arrived at VAFB to begin final preparations for launch.

34. April 16, 2013: NASA Marks Progress on Space Exploration Vision

On the third anniversary of President Barack Obama's visit to Kennedy Space Center, key leaders from across the agency shared progress being made on the Orion spacecraft and infrastructure inside the Operations and Checkout Building high bay.



35. April 27, 2013: Robert Cabana Receives Debus Award

Kennedy Space Center Director Bob Cabana received the prestigious Dr. Kurt H. Debus Award during a gala at the Kennedy Space Center Visitor Complex. Named for the spaceport's first director, the Debus Award was created by the National Space Club Florida Committee to recognize significant achievements and contributions made in Florida to American aerospace efforts.



36. May 3, 2013: Orion Crew Module Undergoes Static Loads Test

In a special test structure inside the Operations and Checkout building high bay, the Orion crew module was put through a series of tests that simulated the massive loads the spacecraft would experience during its mission.

37. May 8, 2013: NASA Awards Contract to Modify the Mobile Launcher

NASA awarded a contract to J.P. Donovan Construction Inc. of Rockledge, Fla., to modify the mobile launcher that will enable the agency's Space Launch System heavy-lift rocket to send humans to Mars and other new destinations in the solar system.



38. May 9, 2013: SNC Completes Dream Chaser Safety Review

SNC Space Systems announced the completion of its first major, comprehensive safety review of its Dream Chaser spacecraft. Dream Chaser and the ULA Atlas V rocket combination are under development with CCP.

39. May 11-15, 2013: SNC Ships Dream Chaser to Dryden

SNC shipped its Dream Chaser spacecraft from the company's facility in Louisville, Colo., to NASA's Dryden Flight Research Center in Edwards, Calif., for its flight test program in collaboration with CCP.



40. May 13-17, 2013: Orion Ground Test Vehicle Undergoes Bolt Tests

Engineers and technicians completed a second set of pyrotechnic bolt tests on the Orion ground test vehicle in the Launch Equipment Test Facility. During the week, five frangible, or breakable, nut detonations were tested between the test vehicle and a launch abort system retention and release mechanism.

41. May 16, 2013: Launch Abort System Jettison Motor Arrives

The jettison motor that is part of the Launch Abort System for the Orion spacecraft arrived at Kennedy's Launch Abort System Facility for processing.



42. May 20, 2013: NASA Signs Agreement with United Paradyne

NASA's Kennedy Space Center signed a new partnership agreement with United Paradyne Corp. of Santa Maria, Calif., for use of the center's legacy Hypergolic Maintenance Facility.

43. May 20-24, 2013: Fourth Annual Robotic Mining Competition

College and university teams from the U.S. and around the world gathered at the Kennedy Space Center Visitor Complex to compete in NASA's Fourth Annual Robotic Mining Competition.



44. May 22, 2013: Administrator Flies Approach-and-Landing Simulations

NASA Administrator Charlie Bolden flew simulations of a Dream Chaser approach and landing to evaluate the spacecraft's subsonic handling at NASA's Langley Research Center in Hampton, Va. Steve Lindsey, SNC's director of flight operations and former astronaut, gave Bolden, also a former astronaut, pointers for landing the simulated vehicle.



45. May 31, 2013: Boeing Completes Spacecraft and Rocket Milestones

Boeing announced the completion of two milestones for its agreement with CCP. Boeing completed wind tunnel testing of its CST-100 spacecraft and integrated launch vehicle, the ULA Atlas V rocket, at the agency's Ames Research Center in Moffett Field, Calif. The companies also worked together to test a newly developed component of the Atlas V's Centaur upper stage.

46. June 6, 2013: Orion Spacecraft Undergoes Pressure Tests

NASA's Orion crew module passed a series of static loads tests that mimicked the stresses of spaceflight in Kennedy's Operations and Checkout Building high bay.

47. June 15, 2013: Launch Services Program Aids CubeSat Launch

Several tiny spacecraft known as CubeSats were launched on a Prospector 18 rocket from California's Mojave Desert as part of the Student Launch Project in partnership with the Launch Services Program. Students from Merritt Island High School in Florida were among the four schools that designed and developed CubeSats for the project.



48. June 25, 2013: New Roller Bearings Readied for Crawler-Transporter 2

Inside the Vehicle Assembly Building, new roller shaft bearings were prepared for installation on crawler-transporter 2.



49. June 27, 2013: NASA's IRIS Spacecraft Launches

An Orbital Sciences L-1011 carrier aircraft, with a Pegasus XL rocket attached, launched from VAFB carrying NASA's Interface Region Imaging Spectrograph (IRIS) spacecraft. The spacecraft was placed in orbit by the Pegasus XL rocket at 10:27 p.m. EDT (7:27 p.m. PDT).



50. June 28, 2013: NASA and Space Florida Begin Partnership Discussions

NASA selected Space Florida, the aerospace economic development agency for the state of Florida, for negotiations toward a partnership to maintain and operate Kennedy's historic Shuttle Landing Facility.

51. June 29, 2013: Space Shuttle Atlantis Facility Officially Opens

The 90,000-square-foot "Space Shuttle Atlantis" facility formally opened at the Kennedy Space Center Visitor Complex. The facility features interactive exhibits that tell the story of the 30-year Space Shuttle Program and highlights the future of space exploration.

52. July 2, 2013: SpaceX Completes Two Human-Critical Reviews

SpaceX announced completion of two human-critical milestones for its partnership with CCP. SpaceX outlined all the steps the company will take to certify its system for crewed missions and detailed its plans for a launch pad abort test.

53. July 11, 2013: OPALS Experiment Arrives at Kennedy

NASA's Optical Payload for Lasercomm Science (OPALS), an optical technology demonstration experiment for the space station, arrived at Kennedy from NASA's Jet Propulsion Laboratory in Pasadena, Calif.



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- 54. July 11, 2013: Langley Conducts High-Speed Wind Tunnel Testing on Dream Chaser**
NASA's Langley Research Center in Hampton, Va., conducted hypersonic testing of Dream Chaser modules for SNC as part of the CCiCap agreement with CCP in order to obtain necessary data for the material selection and design of the spacecraft's thermal protection system.
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- 55. July 17-18, 2013: SpaceX Completes Crewed Orbit and Entry Review**
During a preliminary design review at SpaceX headquarters, company engineers presented NASA representatives and aerospace industry experts detailed analyses of Dragon systems critical to keeping crews safe in orbit and during re-entry operations.
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- 56. July 22, 2013: Astronauts Fit Check Boeing's CST-100**
NASA astronauts Serena Aunon and Randy Bresnik performed a pressurized space suit fit check evaluation of Boeing's CST-100 spacecraft at the company's Houston Product Support Center near Johnson Space Center.



- 57. Aug. 1, 2013: CCtCap Preproposal Conference Hosted by Kennedy Space Center**
NASA's CCP at Kennedy hosted the Commercial Crew Transportation Capability (CCtCap) preproposal conference. The purpose of the conference was to involve aerospace industry representatives in the CCtCap draft Request for Proposal process and provide a greater understanding for both parties before the release of the official RFP in the fall of 2013.
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- 58. Aug. 12-16, 2013: Orion Stationary Recovery Test Completed**
NASA and the U.S. Navy completed a stationary recovery test of the Orion boilerplate test article in the water in proximity to a U.S. Navy ship at the Naval Station Norfolk near the agency's Langley Research Center.



- 59. Aug. 15, 2013: Four Milestones Added to Commercial Crew Agreements**
NASA announced it added additional milestones to agreements with three U.S. commercial companies that are developing spaceflight capabilities that could eventually provide launch services to transport NASA astronauts to the space station from U.S. soil.
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- 60. Aug. 19, 2013: NASA Administrator Tours CST-100**
Boeing's Director of Crew and Mission Operations Chris Ferguson explains the control system of a mock-up CST-100 to NASA Administrator Charlie Bolden at the company's Houston Product Support Center. Boeing showcased its work on a fully outfitted test version of the spacecraft to Bolden and Johnson management.



- 61. Aug. 26, 2013: Boeing Completes Mission Control Center Interface Test**
For the first time, the Mission Control center at Johnson Space Center tested communications with a commercial, crew-capable spacecraft, as Boeing conducted an interface test between the control center and software planned for the company's CST-100 spacecraft.
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- 62. Sept. 19, 2013: New JEL Cylinder Installation Begins on Crawler-Transporter 1**
Crawler-transporter 1 rolled out from Vehicle Assembly Building high bay 3 to the crawler-transporter yard so installation of two jacking, equalization and leveling (JEL) qualification units could begin.



- 63. September 2013: Dragon Mock-up Prepared for Drop Test**
SpaceX displayed a mock-up Dragon crew capsule in September 2013 at its headquarters in Hawthorne, Calif. The mock-up will be used for drop testing to verify the spacecraft's parachute landing system.



CENTER PLANNING & DEVELOPMENT

The Center Planning and Development Directorate (CPDD) is the “front door” to NASA’s Kennedy Space Center. As the center undergoes a transformation from a government-only launch complex to the world’s premier spaceport for government and commercial space industries, CPDD leads the charge by providing a clear vision for Kennedy’s future through its Master Plan’s Future Land Use Map. The Master Plan covers a twenty year period from 2013 to 2032. The changes at Kennedy will improve its appeal to commercial partners as it morphs into a multi-user spaceport. To learn more about Kennedy’s Master Plan, visit <http://masterplan.ksc.nasa.gov>.

During Fiscal Year 2013, CPDD began developing partnerships crucial to achieving this vision.

The Space Coast Energy Consortium (SCEC) signed a non-reimbursable Umbrella Space Act Agreement (SAA) on Jan. 8 to jointly develop the Space to Energy Regional Innovation Center (RIC) that will sponsor, support and accelerate the commercialization of emerging energy products.

United Paradyne Corp. (UPC) signed a 15-year partnership agreement Jan. 14 for the use of the Hypergolic Maintenance Facility (HMF). UPC, a privately held

small business, works in propellant services, providing various operations and engineering support related to hypergols and cryogenic services. The company will use the HMF to provide offline processing support services in the storage, delivery, handling and maintenance of hypergolic and green propellant commodities and satellite fueling operations. They also are refurbishing, manufacturing and assembling ground test support equipment.

On March 15, Micro Aerospace Solutions Inc. (MAS) signed a two-year agreement for the use of an offline hardware

“nanosatellite” flight hardware and payload assembly, as well as testing and checkout operations for small satellite and International Space Station payloads and propulsion-related testing for different types of rockets.

PaR Systems Inc., a world leader in material handling, automation and robotic solutions, signed an agreement on April 1 for the use of the Hangar N facility on Cape Canaveral Air Force Station, adjacent to Kennedy, and its unique nondestructive testing equipment. Under this 15-year agreement, PaR systems operates and maintains the facility to



processing “clean room” laboratory and office space in Kennedy’s Space Station Processing Facility. MAS, a small business that specializes in electrical and mechanical system design and consultation, is using the area to perform

Kennedy Space Center Director Bob Cabana talks with Craig Technologies founder and chief executive officer Carol Craig during a community open house at the Aerospace and Defense Manufacturing Center in Cape Canaveral, Fla.

Space Florida Chief Operating Officer Jim Kuzma comments on the prospect of a new agency partnership during a news conference at the Kennedy Space Center Visitor Complex on June 28, 2013.

perform nondestructive evaluation testing and other related aerospace, marine and industrial products services. The use of Hangar N will enable PaR to provide support to NASA's Space Launch System and Orion programs and commercial launch customers.

On May 23, NASA issued an announcement for proposals for the commercial use of Launch Pad 39A at Kennedy. Use of the launch pad by industry is designed to encourage commercial space activities along Florida's Space Coast and fully use the historic launch complex. Launch Pad 39A originally was designed to support NASA's Apollo Program and later was modified to launch space shuttles.

NASA Administrator Charles Bolden and Kennedy Center Director Robert Cabana announced June 28 the selection of Space Florida, the aerospace economic development agency for the state of Florida, for negotiations toward a partnership agreement to maintain and

operate the Shuttle Landing Facility (SLF). The SLF features a concrete runway 15,000 feet long and 300 feet wide capable of handling all types and sizes of aircraft and horizontal launch and landing vehicles. To learn more about the center's partnerships, visit <http://kscpartnerships.ksc.nasa.gov>.

CPD's Technology Transfer Office entered into seven patent licensing agreements this year.

Kennedy also engaged with two institutions, Rollins College and Brevard Workforce, on programs involving students and mentors to generate commercialization plans for NASA technology, leading to an exclusively licensed high-precision position sensor to a startup company, Juntura, formed by the Rollins College team of MBA students. The Brevard Workforce Startup Quest

Entrepreneurial Training Program was a huge success and may lead to additional licensing of NASA technology.

Kennedy executed an agreement with Toxicological Environmental Associates for testing of the latest remediation technology for removing PCB's from sediments, soils, groundwater and other in situ media.

To learn more about Kennedy's Technology Transfer efforts, visit <http://technology.ksc.nasa.gov>. ✨

NASA's chief technologist and a team of innovative engineers discuss some of NASA's cutting-edge projects with media representatives touring the Swamp Works at Kennedy Space Center.



COMMERCIAL CREW PROGRAM

NASA's Commercial Crew Program and its industry partners made significant advances in the design and testing of the next generation of American-made spacecraft during Fiscal Year 2013. From performing tests in simulators in order to prove flight deck control concepts to captive-carry evaluations of a winged spacecraft, this groundbreaking approach to spaceflight continues its steady march toward achieving a safe, reliable and cost-effective crew transportation system.

Companies also tested a newly developed, hydrogen-fueled engine and performed some of the most in-depth analysis of potential rockets ever undertaken in the effort to prove a reliable satellite launcher can safely loft astronauts into orbit. The agency intends to use new commercial capabilities to fly U.S. astronauts to and from the International Space Station within the next four years.

FY13 started off strong as the program announced it would award contracts to companies far enough into the design and development of their integrated crew transportation systems that they could begin to establish certification plans aligned with agency safety and mission requirements. Boeing Space Exploration of Houston, Sierra Nevada Corporation (SNC) Space Systems of Louisville, Colo., and Space Exploration Technologies



Bruce Jackson, an aerospace engineer at NASA's Langley Flight Research Center in Hampton, Va., briefs astronauts Rex Walheim, left, and Gregory Johnson as they evaluate Sierra Nevada Corporation, or SNC, Space Systems' Dream Chaser landing simulation on May 15, 2013, in support of NASA Commercial Crew Program efforts.



Test articles of the crewed Dragon spacecraft are prepared Aug. 22, 2013, for the parachute drop test and pad abort test through the company's partnership with NASA's Commercial Crew Program.



Engineers and managers work inside a simulator of The Boeing Company's CST-100 spacecraft during evaluations of potential designs and software functions on Sept. 12, 2013, at the company's Houston location.



Blue Origin test fires the thrust chamber assembly for its BE-3 liquid oxygen, liquid hydrogen rocket engine at NASA's Stennis Space Center near Bay St. Louis, Miss., in October 2012.

Boeing's CST-100/United Launch Alliance (ULA) Atlas V rocket, SNC's Dream Chaser/ULA Atlas V and SpaceX's Dragon/Falcon 9.

More than 200 people in the groundbreaking program, based primarily at Kennedy Space Center with offices at Johnson Space Center in Houston and Marshall Space Flight Center in Huntsville, Ala., and additional support personnel across the country, are working in tandem with these companies to improve and advance designs that will lead to new human spaceflight capabilities.

This new way of doing business is not just an endeavor of NASA and its primary partners. At the close of FY13, there were more than 100 companies in 33 states contributing to system and subsystem components, making this a truly national effort.

Throughout FY13, three companies wrapped up their Commercial Crew Development Round 2 (CCDev2) agreements with CCP as well. ULA rounded out its unfunded CCDev2 partnership with a detailed review of the Atlas V system hardware that would ensure crew safety during launch and ascent, while Boeing and SpaceX transitioned from CCDev2 element design to CCiCap integrated spacecraft and launch vehicle design

(SpaceX) of Hawthorne, Calif., received Certification Products Contracts (CPC) valued at approximately \$10 million each in December 2012.

The CPC contractors are the same three

companies continuing to make great strides in fine-tuning and testing the designs of their spacecraft and rocket combinations during the Commercial Crew Integrated Capability (CCiCap) initiative. Those combinations are

progress. SNC continued development work under CCDev2 in parallel with work under CCiCap. CCP also extended its CCDev2 partnership with Blue Origin in an unfunded capacity, offering continued technical and design support for the



The Boeing Company performed simulated contingency water landing scenarios with a mock-up CST-100 spacecraft at Bigelow Aerospace's headquarters near Las Vegas on July 8, 2013.

An Erickson Air-Crane helicopter lifts Sierra Nevada Corporation's Dream Chaser flight vehicle during a captive-carry flight test on Aug. 22, 2013, at Edwards Air Force Base, Calif.



Blue Origin's pusher escape system rockets its crew capsule away from a simulated propulsion module launch pad at the company's Van Horn, Texas, launch site, demonstrating a key safety system for both suborbital and orbital flights.

company's Space Vehicle and Reusable Booster System.

in many respects as private companies take the largest role they've ever had in developing designs and applying a wealth of innovations and new thinking to their dynamic industry.



All of CCP's industry partners continue to learn important lessons about their designs, and NASA is at their sides to offer guidance and support built on the agency's 50 years of spaceflight and cutting-edge aerospace experience. In turn, NASA is gaining critical insight into the design and test process that will contribute significantly toward achieving safety certification.

Spaceflight has never been easy, but the progress of CCP and its partners has been robust and groundbreaking

CCP remains fully committed to its mission of supporting its partners and advancing the nation's goals of launching our astronauts on American rockets and spacecraft from U.S. soil. The horizon of the next fiscal year is bright as the program prepares to roll out and award contracts for the Commercial Crew Transportation Capability (CCtCap) phase, which will include flight testing and crewed demonstration missions to the International Space Station. ✈

On Jan. 25, 2013, a SpaceX technician checks out a Merlin engine designed to launch Falcon 9 rockets at the company's headquarters in Hawthorne, Calif.



The Landsat Data Continuity Mission spacecraft lifted off Feb. 11, 2013, atop a United Launch Alliance Atlas V rocket from California's Vandenberg Air Force Base. The Landsat satellite will continue to obtain valuable data and imagery to be used in agriculture, education, business, science and government.

LAUNCH SERVICES PROGRAM

NASA's Launch Services Program (LSP) at the Kennedy Space Center launched two missions that support the agency's Science Mission Directorate and Human Exploration and Operations Mission Directorate. LSP also continued to support advance planning for about 20 future missions that are in the early stages of formulation, provided integration and launch services for 12 missions already on contract, and provided advisory services for nine other missions.

NASA's Tracking and Data Relay Satellite-K (TDRS-K) was launched on Jan. 30, 2013, when it lifted off atop a United Launch Alliance (ULA) Atlas V

rocket from Space Launch Complex 41 at Cape Canaveral Air Force Station in Florida. The TDRS-K spacecraft is part of the next-generation series in the Tracking and Data Relay Satellite System, a constellation of space-based communication satellites providing tracking, telemetry, command and high-bandwidth data return services.

LSP's support of the TDRS-K mission included a complex radio frequency (RF) analysis to ensure the spacecraft would be protected from uncontrolled RF sources from the time the satellite left its manufacturing facility through payload fairing separation during ascent. The analysis resulted in a considerable

cost savings and helped ensure mission success.

NASA's Landsat Data Continuity Mission (LDCM) began its mission on Feb. 11, 2013, when it launched on a ULA Atlas V rocket from Space Launch Complex 3 at Vandenberg Air Force Base in California. The LDCM is the future of Landsat satellites and will continue to obtain valuable data and imagery to be used in

Space Launch Complex 41 on Cape Canaveral Air Force Station in Florida is illuminated by a United Launch Alliance Atlas V 401 rocket as it lifts off on Jan. 30, 2013, carrying NASA's Tracking and Data Relay Satellite-K (TDRS-K) to orbit.





In the Astrotech processing facility at Vandenberg Air Force Base, Calif., technicians perform close-out inspections on NASA's Landsat Data Continuity Mission satellite.

Island, Va. The spacecraft was boosted atop a U.S. Air Force Minotaur V rocket integrated by Orbital Sciences Corp. The Minotaur V is designed to support small missions requiring geosynchronous transfer or translunar orbits.

During the past year, LSP implemented new approaches for Falcon 9 launch vehicle certification to better utilize resources and more effectively execute work to support the Jason-3 mission. Scheduled to launch in 2015 aboard a Falcon 9, Jason-3 will be the fourth in a U.S.-European series of satellites that measure the topography of the ocean floor.

These new initiatives have resulted in a new, dedicated team structure for the hardware qualification certification element for SpaceX's Falcon 9 rocket. The approach has resulted in continuity, optimizing skills and resources, as well as improved communication between LSP and SpaceX engineers.

LSP also began a one-year coupled loads independent verification and validation effort on the Falcon 9 rocket. Coupled loads analysis (CLA) is a critical process for many high-technology systems, including launch vehicles and satellites. CLA predicts responses caused by major dynamic events, such as liftoff. The analysis helps to minimize risk and maximize the probability of mission success. This effort will give LSP the capability to not only verify SpaceX coupled loads analyses, but also run in-house studies to assist other spacecraft customers with their designs.

agriculture, education, business, science and government. The Landsat Program provides repetitive acquisition of high-resolution multispectral data of the Earth's surface on a global basis.

Launching these two missions from opposite coasts within 12 days is the shortest timeframe between two Atlas V launches to date.

The Interface Region Imaging Spectrograph (IRIS) spacecraft launched aboard an Orbital Sciences Corp. Pegasus XL on June 27, 2013, from Vandenberg to open a new window of discovery. IRIS will trace the flow of energy and plasma through the

chromosphere and transition region into the sun's corona using spectrometry and imaging. The satellite also is designed to provide significant information to increase understanding of energy transport into the corona and solar wind providing an archetype for all stellar atmospheres. Engineers in LSP performed extensive analyses of the updated Pegasus autopilot flight software, contributing to the success of the IRIS mission.

LSP served in an advisory role supporting the Lunar Atmosphere and Dust Environment Explorer, or LADEE, mission launched Sept. 6, 2013, from the Mid-Atlantic Regional Spaceport at NASA's Wallops Flight Facility in Wallops



The Pegasus rocket carrying the Interface Region Imaging Spectrograph (IRIS) satellite ignites its engine following launch June 27, 2013, off the coast of Vandenberg Air Force Base.

on July 28, 2016, also from Vandenberg. This three-year mission will quantify polar ice-sheet contributions to current and recent sea-level change and the linkages to climate conditions.

In March, Astrotech was awarded a contract to provide the Commercial Payload Processing Facility for the Soil Moisture Active Passive (SMAP) spacecraft. This mission will be launched on a Delta II in October 2014 from Vandenberg. The satellite will provide a capability for global mapping of soil moisture and freeze-and-thaw states with unprecedented accuracy, resolution and coverage.

In August, NASA awarded the Origins, Spectral Interpretation, Resources Identification, Security-Regolith Explorer (OSIRIS-REx) mission, which has a scheduled launch between Sept. 4 and Oct. 12, 2016, aboard a ULA Atlas V from Cape Canaveral. The OSIRIS-REx spacecraft will travel to a near-Earth

Awarded Contracts for Future Missions

In November 2012, NASA awarded the Indefinite Delivery/Indefinite Quantity (IDIQ) West Coast Commercial Processing Payload Facility (PPF) contracts at Vandenberg to Astrotech Space Operations and Space Systems International. NASA awarded the similar East Coast Commercial PPF contract to Astrotech in January 2013. These contractors will provide all resources necessary to deliver and perform the payload processing for LSP missions.

Also in January, NASA selected Astrotech to provide the Commercial Payload Processing Facility at Vandenberg for the payload processing of the Orbiting Carbon Observatory-2 (OCO-2)

spacecraft. OCO-2 is to launch aboard a Delta II rocket in July 2014 from Vandenberg. This two-year mission will be NASA's first dedicated Earth remote-sensing satellite to study atmospheric carbon dioxide from space.

The Ice, Cloud and Land Elevation Satellite-2 (ICESat-2) mission was awarded to ULA in February, and is scheduled to launch aboard a Delta II

On Sept. 23, 2013, inside the Payload Hazardous Servicing Facility, engineers and technicians test deploy the twin solar arrays on the Mars Atmosphere and Volatile Evolution, or MAVEN, spacecraft.



carbonaceous asteroid “Bennu,” conduct a comprehensive study and return a sample to Earth in 2023 to investigate planet formation and the origin of life. Data collected from the asteroid also will aid in improved understanding of asteroids that can impact Earth.

A request for proposals was issued to purchase a new “nano” launch service from a small business to launch orbital payloads, such as CubeSats, of at least 33 pounds (15 kilograms). The program called NEXT, or NASA Launch Services (NLS) Enabling eXploration and Technology, is designed to secure launch services outside standard NLS contracts, focusing on a high-risk tolerant approach that minimizes government overhead, insight and approvals.

The NEXT launch service is scheduled to deliver up to nine CubeSats to a 264-mile (425-kilometer) orbit on a Federal Aviation Administration-licensed rocket in 2016. If successful, this could lead to

On Feb. 11, 2013, at Vandenberg Air Force Base’s Space Launch Complex 3E, the gantry rolls back from NASA’s Landsat Data Continuity Mission satellite mounted atop a United Launch Alliance Atlas V rocket.

Student engineers evaluate the CubeSats during lab tests at Kennedy Space Center. The two craft will fly together on a brief, high-altitude flight to check out their systems, as well as those on other payloads.

additional opportunities for the many CubeSats awaiting launch opportunities.

Partnerships

LSP partnered with the Student Launch Project to launch four tiny spacecraft, known as CubeSats, aboard a Prospector 18 rocket from California’s Mojave Desert on June 15. These nano-satellites were four-inch cubes developed by several different organizations, including the California Polytechnic Institute in San Luis Obispo, NASA’s Ames Research Center, and Merritt Island High School in Florida.

These small spacecraft provide a viable option for space-related research to schools and universities around the world. To date, 22 CubeSats have been manifested, and approximately 50 are manifested to launch in 2014.



LSP continued to play important roles in orbital debris and collision avoidance activities by supporting NASA policy discussions and working with launch service providers to implement orbital debris guidelines. A recent example includes LSP’s collaboration with United Launch Alliance to perform a controlled re-entry of the Atlas V Centaur upper stage after it deployed the Radiation Belt Storm Probe satellite.

LSP also is continuing to support the evaluation and use of new commercial launch vehicles in partnership with the U.S. Air Force and National Reconnaissance Office. A new entrant’s forum was established to study launch vehicle assessments across the federal government.

For more information about the Launch Services Program at Kennedy, visit <http://www.nasa.gov/centers/kennedy/launchingrockets/index.html>. ✨



GROUND SYSTEMS DEVELOPMENT & OPERATIONS PROGRAM

The Ground Systems Development and Operations (GSDO) Program at Kennedy Space Center made significant progress in developing the necessary ground systems, infrastructure and operational approaches required to safely process, assemble, test and launch NASA's next generation of rockets and spacecraft. These include the Space Launch System (SLS) and the Orion

On June 12, 2013, construction workers remove the flame trench deflector that sits below and between the left and right crawlerway tracks at the Kennedy Space Center's Launch Pad 39B. The pad is being refurbished to support NASA's Space Launch System and other launch vehicles.

crew module. The continued efforts to upgrade or modify applicable facilities and pertinent ground support equipment are directly in support of NASA's exploration objectives.

For the first time since NASA's Apollo-era rockets and space shuttles lifted off on missions from Launch Complex 39, one of the launch pads is undergoing extensive upgrades to support the agency's 21st century space launch complex.

At launch pad B, construction workers removed the legacy flame deflector that sits below and between the parallel pad surface crawlerway track panels, along

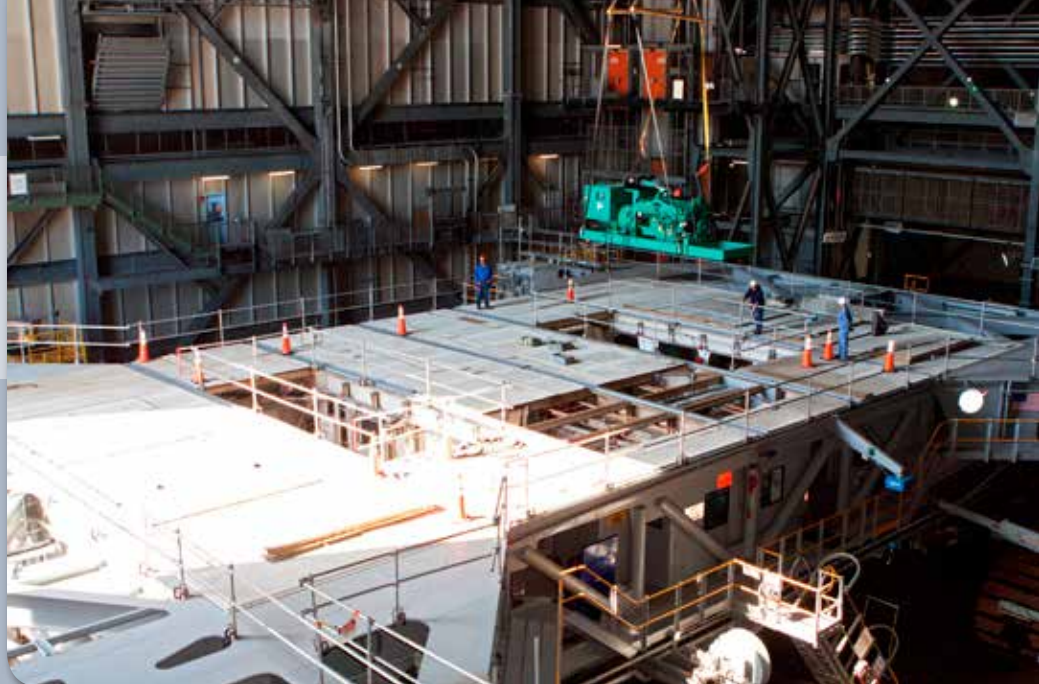
with Apollo-era bricks from both walls of the flame trench. A new universal flame deflector is being designed that will support the SLS rocket and a variety of other launch vehicles.

One of the most visible new features on pad B is a steel and concrete structure that houses two elevators and the associated machinery required to operate them. The new elevators will provide access from the surface to the "0" level, or deck, of the mobile launcher.

Portions of the crawlerway that lead from the Vehicle Assembly Building (VAB) to Launch Pads 39A and 39B are being



Inside the Vehicle Assembly Building at Kennedy Space Center, technicians monitor the progress April 24, 2013, as a large crane lifts a new Cummins engine and generator for installation inside crawler-transporter 1 (CT-1).



upgraded. All of the crawler track panels on the surface of the pad have been removed and the concrete surface and catacomb roof below are being repaired. New crawler track panels will be installed. The upgrades will improve the foundation and prepare it to support the weight of the SLS and mobile launcher on the crawler-transporter (CT) during rollout.

Over time, the crawlerway surface was compacted by the weight of Apollo/Saturn V and space shuttle rollouts. Construction crews removed the Alabama river rock from the surface and restored the layer of lime rock below to its original depth. New river rock was added on top.

In the VAB, upgrades continued on crawler-transporters 1 and 2. For more than a year, CT-2 has been undergoing a major tuneup to enable it to carry the greater loads anticipated with the SLS. Technicians removed and replaced the roller bearings and roller bearing assemblies.

CT-2 also received new AC generators, electronics, cables, tubing and hydraulic components. Its fuel tanks and hydraulic systems were cleaned. The modifications are designed to ensure the crawler's ability to transport launch vehicles to the launch complex.

In November, CT-2 was rolled out to Launch Pad 39A where it picked up the mobile launcher platform and then performed a series of maneuvers to test steering alignment, exhaust bellows, braking, laser docking and how it handled the pad slope.

Technicians installed piping for a new exhaust system in CT-1. Work continued

on the crawler as part of its general maintenance so that it could be available to carry a variety of launch vehicles to the launch pad.

Space shuttle-era work platforms were removed from high bay 3 in the VAB. A new platform system is being developed that can accommodate different types of launch systems, including the SLS. The effort is part of a centerwide modernization and refurbishment initiative.

The Multi-Payload Processing Facility (MPPF) is undergoing extensive upgrades and modernizations to support processing of Orion spacecraft for the agency's exploration missions. The building once supported the processing of various payloads and spacecraft for the agency's Space Shuttle and Launch Services Programs.

GSDO is overseeing the upgrades to the 19,647-square-foot building to accommodate the Orion spacecraft.

At Kennedy Space Center's Launch Pad 39B, all of the old crawler track panels have been removed from the surface, and construction workers are repairing the concrete surface and catacomb roof below. Framing for the new crawler track panels is being installed in repaired areas of the pad surface.





Technicians in the Vehicle Assembly Building at the Kennedy Space Center remove cover plates in preparation for replacing the roller bearing assemblies on crawler-transporter 2 (CT-2) on June 18, 2013.

Upgrades include installing new pneumatics systems for gaseous helium, gaseous oxygen, gaseous nitrogen and breathable air, hypergolic systems for monomethylhydrazine, hydrazine and nitrogen tetroxide, and a ground cooling system.

The MPPF primarily will be used for Orion hypergolic fueling, ammonia servicing and high-pressure gas servicing and checkout before the spacecraft is transported to the VAB for integration with the Space Launch System.

In the Launch Control Center, all four firing rooms (FR) have undergone extensive upgrades and will be ready to meet the near- and far-term goals of GSDO. Firing Room 1 has been equipped to support the launch the Exploration Mission-1 and future launches of Orion on the SLS. The control room, equipped to support

50, also will provide support for test and checkout of ground support equipment and hardware. FR1 also may be available to support potential commercial endeavors.

The old launch consoles, raised floors, power and data cables, obsolete air handlers and plumbing have been removed from Firing Rooms 2 and 3. New raised flooring has been installed and upgraded communications infrastructure is in place. Firing Room 3 hosts the Launch Control System development sets and the Customer Avionics Integration Development and Design Analysis Laboratory. These systems provide support to the hardware, software and simulations development for the launch control system in FR1.

In Firing Room 4, the legacy consoles, Launch Processing System and cabling that once supported the Space Shuttle Program have been removed. Construction has commenced on a multi-use control room to support NASA and commercial needs. The design incorporated five control room areas

that are flexible to meet current and future user requirements. The equipment and consoles from FR4 have been moved to FR2 for possible future reuse.

NASA awarded a contract to J.P. Donovan Construction Inc. of Rockledge, Fla., to modify the mobile launcher, which is one of the key elements of ground support equipment that is being upgraded by GSDO.

The mobile launcher will be structurally modified to be able to carry the SLS to Launch Pad 39B.

Eight reaction control system pods for Orion's Exploration Flight Test-1 (EFT-1) arrived at the Operations & Checkout Building from the manufacturer, Aerojet, in Redmond, Wash. All eight pods were proof pressure and leak tested, as well as valve leak tested. Rocket engine functional testing was performed to prepare the pods for installation on the Orion crew module.

During the year, crane operators and technicians practiced lifting and stacking techniques on full-size mock-ups of the Orion spacecraft and the launch abort system in the VAB in order to keep processing procedures and skills current.

The GSDO team continues to upgrade its skills, facilities and ground support equipment to safely handle a variety of rockets and spacecraft during assembly, transport and launch, including EFT-1 in 2014 and SLS in 2017. ✨

ORION PROCESSING

Preparing Orion for Exploration Flight Test-1

Inside the Operations and Checkout (O&C) Building high bay, engineers and technicians accomplished a static loads test on the Orion crew module. Hydraulic cylinders were attached to Orion and pressure was slowly applied to various areas of the vehicle to simulate the loads it will be exposed to at different phases of the mission.

The Orion ground test vehicle was put through a series of pyrotechnic bolt tests in the Launch Equipment Test Facility (LETf). Technicians individually tested five frangible, or breakable, nut detonations between the ground test vehicle and a launch abort system (LAS) retention and release mechanism.

The ground test vehicle is being used for pathfinding operations, including simulated manufacturing and assembly procedures in the O&C.

Tests on the Orion crew module and the ground test vehicle are being performed to prepare for Orion's EFT-1, scheduled to launch on a United Launch Alliance Delta IV rocket.

Several components for Orion's launch abort system (LAS) arrived at the Launch Abort System Facility for checkout and processing, including the attitude control motor and the launch abort motor. The LAS is designed to safely pull the Orion crew module away from the launch

vehicle in the event of an emergency on the launch pad or during the initial ascent of the SLS.

Engineers and technicians at Kennedy, Langley Research Center in Virginia, Johnson Space Center in Houston and Lockheed Martin Space Operations in Denver, Colo., prepared unique hardware that was used in a fit check of equipment at Langley.

The crew module recovery cradle, the boilerplate handling fixture bumper assembly and the Orion boilerplate test article – a life-size test version of the spacecraft – were assembled and tested in one place, at the "Trim Pad" near Langley.

The handling fixture assembly was developed at Kennedy's Prototype Laboratory and manufactured at the LETf by several Engineering Services contractors. The assembly frame and

bumper will be used to guide the Orion test article into the proper orientation over the handling fixture.

For one week in August, a stationary recovery test was performed on the Orion boilerplate test article and associated ground support equipment at the Naval Station Norfolk near NASA's Langley Research Center in Virginia. NASA and the U.S. Navy conducted the tests to practice recovery of the Orion crew module and forward bay cover during splashdown in the water after return from a deep-space mission. The test allowed the teams to demonstrate and evaluate the recovery processes, procedures, hardware and personnel in a controlled environment. ✈

Inside the Operations and Checkout Building high bay at Kennedy Space Center technicians help secure the Orion crew module onto a work stand June 7, 2013, after a crane was used to lift it out of a special test cell.



GROUND PROCESSING

The Ground Processing (GP) Directorate continued to establish itself as the processing and operations organization of choice for the Kennedy Space Center in Fiscal Year 2013, providing interfaces and allowing focused and coordinated support for their customers.

Throughout the year, the GP team successfully supported the Ground Systems Development and Operations (GSDO) Program, Space Launch Systems (SLS) Program, Orion/Multi-Purpose Crew Vehicle (MPCV) Program, International Space Station (ISS) payload processing, Launch Services Program (LSP), completed Space Shuttle Transition and Retirement (T&R), and provided launch and processing expertise to the new and

emerging Commercial Crew Program, and the Advanced Explorations Systems (AES) and Space Technology Mission directorate projects.

The Test Operations Support Contract (TOSC) was awarded to Jacobs Technology Inc. during the first quarter of the year. TOSC is a GP-managed contract, replacing the individual legacy contracts for space shuttle processing and ISS payload processing, in order to better posture Kennedy to transition to its future state as a multi-user spaceport. The contract award was announced in mid-December 2012 and had a very successful 60-day phase-in period from Jan. 1 to Feb. 28, 2013. Continuity of service to all customers was achieved, including supporting a SpaceX launch

March 1, 2013, along with payload processing support for the JAXA mission.

A single contractor performing processing operations both in the Launch Complex 39 and the Industrial areas ensures work is prioritized across the center to meet requirements in the most efficient and cost-effective manner. Consolidation of numerous functions under TOSC ultimately will result in services being provided at the most affordable costs, a key necessity as one of the organization's mandates is to adapt the center's unique capabilities and equipment from supporting a single spacecraft to a system that efficiently processes and safely launches several different craft, many operated by private enterprise.

The GP/TOSC team is made up of extremely talented individuals who have been supporting the nation's space program at Kennedy for more than 30 years in some cases. This expertise and knowledge of spacecraft and launch vehicle processing

Inside the Operations and Checkout Building high bay, workers monitor the progress as a crane lowers the Orion crew module onto a dolly.





have been applied and leveraged significantly by the GSDO, SLS, and Orion/MPCV programs. GP personnel have provided critical engineering and operations expertise as they have participated or led numerous efforts to meet major program milestones and deliverables.

GP led the document review of the SLS Preliminary Design Review at Kennedy, providing significant operational input on the SLS design. GP provided critical support to the Orion Exploration Flight Test-1, known as EFT-1, mission preparations by leading the Multi-Payload Processing Facility Crew Module Ammonia Servicing System Ground Support Equipment Verification and Validation effort, as well as EFT-1 recovery procedures and schedules development. GP's launch and integrated processing

expertise has proven valuable during GSDO/SLS Program Assessment Requests, particularly the leadership provided during the Emergency Egress System down-select activity. This expertise also has been called upon to lead the development of the Ground Operations Processing Database, including the launch countdown timeline, and the Vehicle Integration and Launch Operations Implementation Plan. GP's landing and recovery expertise has been utilized to develop and assess landing and recovery options for the Orion MPCV. GP provided leadership for the Launch Control System software/hardware validation in Firing Room 1, as well as the requirement, schedule and display development for the Ground and Flight Application Software Team.

The GP directorate has provided critical

Smoke fills the air as the Project Morpheus prototype lander's engine fires during a tether test on Dec. 6, 2013, at the north end of the Shuttle Landing Facility.

operations and testing expertise for ongoing programs, including the ISS and LSP payload processing. ISS Program Orbital Replacement Unit processing included the Nitrogen Oxygen Recharge System (NORS) GFA activation and validation operations. ISS Utilization and ISS Research Processing included Optical Payload for Lasercomm Science (OPALS) unit testing and Stratospheric and Aerosol Gas Experiment (SAGE-III) testing. The GP/TOSC team conducted preplanning and operations for the MAVEN (Mars Atmosphere and Volatile Evolution) spacecraft launched by LSP.

NASA Associate Administrator Robert Lightfoot, center, tours the Thermal Protection System Facility, or TPSF, during a visit to Kennedy Space Center on June 4, 2013. From left are Kennedy Director Bob Cabana, Lightfoot, and Martin Wilson, TPSF manager with Jacobs Technology.



GP was a significant contributor to the shuttle transition and retirement effort. In November 2012, shuttle Atlantis was turned over to the Kennedy Space Center Visitor Complex, marking the completion of efforts to transfer major spaceflight assets for public display. Throughout the remainder of the fiscal year, the Transition and Retirement team completed the turnover of shuttle facilities either to other programs or to the center, as well as the disposition of thousands of pieces of shuttle hardware and support equipment. The equipment was screened carefully during disposition to determine whether other programs or agencies might be able to use it.

More than \$1.1 billion of flight and ground hardware, equipment and material that no longer were required to support shuttle flights and ground processing activities were carefully dispositioned. More than half of these assets were transferred directly for use on other active NASA programs, including ISS, SLS, Orion and GSDO, as well as to other federal government organizations having reutilization potential, such as the Department of Defense.

Ground Processing's expertise came into demand from other NASA launch sites, too, as the directorate's staff provided expert test, systems engineering and operations support to Wallops Flight Facility pad testing in support of NASA's commercial partner, Orbital Sciences

Corp., operational readiness and launch of the Antares rocket April 21, 2013.

GP's expertise in operations and launch also was proven invaluable to a number of AES and Space Technology projects in development: the Morpheus prototype lander and the SWORDS (Soldier-Warfighter Operationally Responsive Deployer for Space) project in particular, both continuing with plans for engine tests and launches.

GP is actively engaged in the development of a multi-user spaceport at Kennedy. The organization's operations expertise is tapped to develop concepts of operations for the center and for individual facilities at Kennedy. GP provides input to new customer agreements and ensures success for current commercial customers by serving as a customer focal point to newcomers to Kennedy. GP performs scheduling, integration and coordination

across multiple customers at Kennedy. For example, Ground Processing has maintained the capability to manufacture Thermal Protection System (TPS) components in the TPS Facility (TPSF). This unique capability is of interest to commercial customers, as well as to NASA programs. GP is leading the effort to develop a TPSF cost-sharing model to expand the customer base and make it more equitable for multiple users.

The Ground Processing directorate will continue implementing modifications to aid Kennedy's transition to a multi-user spaceport in the coming years. A host of rockets and spacecraft designs are maturing and Kennedy's facilities continue to adjust alongside them. From launch center changes to processing and launching expertise, Ground Processing offers significant expertise and leadership in a wide area of spaceflight-related fields to an increasing number of customers within and outside NASA. ✨



The International Space Station is the largest, most complex scientific project in history and was designated a National Lab in 2005. As a research outpost, the station is a test bed for future technologies and a research laboratory for new, advanced industrial materials, communications technology and medical research.

ISS GROUND PROCESSING & RESEARCH

The International Space Station is the only permanent, human-occupied space outpost orbiting the Earth today. Critical research is being conducted aboard to answer fundamental long-duration spaceflight questions and overcome possible challenges to placing the first human footprint on another planet.

To support the International Space Station Program's efforts, world-class research conducted at Kennedy Space Center is helping advance our knowledge in basic life (plant) and physical sciences, as well as technology testing for enabling future exploration.

The center's world-class Space Station Processing Facility and other support facilities contain a large array of testing assemblies and hardware that provide support for processing space station customers' payloads and experiments prior to flight on commercial domestic and international vehicles.

The International Space Station (ISS) Ground Processing and Research Project Office at Kennedy is instrumental to the success of station operations by processing payloads, experiments and hardware for delivery to the station. The office also focuses on processing and preparing orbital replacement units, plant biology experiments, increasing research capabilities aboard the station and enabling the station to serve as a test bed for the development of new technologies.

Kennedy implemented technical, cost, schedule and safety requirements



NASA astronaut Karen Nyberg works with a plant experiment in the Destiny laboratory of the International Space Station during Expedition 37 on Oct. 25, 2013.

to meet the goals of the office's two primary customers – the International Space Station Program and the Space Life and Physical Sciences Research and Applications Division at NASA Headquarters. Commercial partnerships also were leveraged for mission success.

SPACEX-2 Support

The ISS team contributed to the success of commercial space by supporting late-load payload operations for the SpaceX-2 mission. Kennedy prepared several payloads, including GLACIER, cold bags, MicroFlow, JAXA Stem Cells, and microbial research and plant experiments. Processing accomplishments included outfitting laboratories and supporting payload developers. SpaceX-2 mission objectives also included the delivery of grapple bars to the station, the first delivery of unpressurized cargo. SpaceX-2 launched March 1, 2013, with its Dragon capsule returning to Earth on March 26, 2013.

Orbital Replacement Unit (ORU) Processing

Kennedy played a key role in providing processing, integration and storage of Orbital Replacement Units (ORUs) for future delivery to the space station. ORUs are used to maintain the ISS platform in a fully operational state.

ORUs processed for the Japan Aerospace Exploration Agency's (JAXA) H-II Transfer Vehicle-4 (HTV-4) mission were a Main Bus Switching Unit and Utility Transfer Assembly. The logistics team safely shipped the hardware and support equipment from Kennedy to Tanegashima, Japan, for final integration with the launch vehicle at the Japan launch site. HTV-4 launched Aug. 3, 2013, delivering the ORUs and an experiment, Space Test



Outredgeous red romaine lettuce plants grow inside a prototype Veggie plant growth chamber in June 2013 at Kennedy Space Center. Veggie and its plant “pillows” will be delivered to the International Space Station aboard the Dragon capsule on SpaceX-3, NASA’s third Commercial Resupply Services mission, in April 2014.

Program-H4 (STP-H4), a miniature array of radiation sensors for monitoring the total dose radiation on a host spacecraft, to the station.

Kennedy also processed 20 lithium hydroxide (LiOH) batteries that are used as a backup system for maintaining the space station’s carbon dioxide levels in control.

Kennedy worked the requirements to process the Common Cabin Air Assembly Heat Exchanger for the SpaceX-3 mission, scheduled to launch in March 2014. The ORU was disinfected, filled and leak checked.

The Nitrogen Oxygen Recharge Systems (NORS), an orbital replacement unit for

the space station, will provide nitrogen and oxygen for crew cabin breathing air, prebreathing in the airlock prior to spacewalks, and pressurization of the ammonia systems on the exterior of the orbiting laboratory. Following a successful critical design review of the NORS ground fill assembly, the high-pressure lines and panels were installed on NORS in the SSPF.

In February 2013, Kennedy met an ISS Program early demonstration request and conducted a successful 7,000 psi helium leak check test of the NORS flight-like pressure vessel and adapters. This was the first high-pressure NORS activity for Kennedy. The ground fill assembly (GFA) will be used to fill the NORS ORUs. Kennedy will process about 100 of these high-pressure vessels through the life of the space station.

In anticipation of future ground support needs at the launch site, the Kennedy team modified and validated a Compressed Gas Trailer for high-pressure oxygen to support NORS filling operations at Kennedy’s Space Station Processing Facility (SSPF).

Research Capabilities

The International Space Station is an unprecedented achievement in global human endeavors to conceive, plan, build, operate, and utilize a research platform in space. With the assembly of the space station at its completion and the support of a full-time crew of six, a new era of utilization for research has begun.

RapidScat

The team shared technical information with payload representatives from the Jet Propulsion Laboratory (JPL) in Pasadena, Calif., on Passive Flight Releasable Attachment Mechanism (PFRAM) integration, handling ground support equipment, testing in the Payload Rack Checkout Unit (PRCU) and other Kennedy payload processing hardware. The Kennedy team designed and manufactured an adapter plate that was used on the RapidScat tilt platform assembly so it could be properly aligned for PFRAM integration.

Kennedy engineers and technicians completed integration of the PFRAM kit onto the RapidScat nadir adapter at JPL.

The work required the team's expertise in critical laser alignment measurements and will ensure final in-orbit assembly of the RapidScat instrument to the adapter. The RapidScat payload remains on schedule to support launch on SpaceX-4.

Commercial Resupply Services (CRS) Orbital Ground Processing Operations

Kennedy worked with the ISS Program to provide recommendations for ground processing services of late-load payloads at NASA's Wallops Flight Facility in Virginia. These recommendations formed

the basis for establishing a defined process for the first planned late-load payload on Orb-1, launched in September 2013.

High Definition Earth Viewing (HDEV)

Kennedy supported the HDEV development team from Johnson with final functional testing of the payload in preparation for launch on SpaceX-3. Kennedy delivered the payload to SpaceX's Launch Complex 40 and assisted with installation into the trunk of the Dragon spacecraft. The payload will

be robotically attached to the space station on the Columbus module. The four, high-definition cameras will stream live video of the Earth for viewing online and analyze the effect of space on video quality.

Space Test Program-H4 (STP-H4)

Kennedy supported the STP-H4 payload team for offline assembly and test operations. STP-H4 was mounted onto a flight EXPRESS Payload Adapter and power quality testing was conducted. All verification requirements were successfully completed, and the test results aided the payload developer in

furthering its design. A successful test in the EXPRESS Logistics Carrier (ELC) hybrid simulator was completed. The payload was transported to Tanegashima, Japan, for launch on the HTV-4 mission.

Stratospheric Aerosol and Gas Experiment-III (SAGE-III)

SAGE-III, a fourth-generation satellite instrument, is designed to observe the long-term health of Earth's upper atmosphere. The Langley Research Center (LaRC) team performed operations on their nadir viewing platform for SAGE-III at Kennedy. Installation of several inserts was completed on the engineering development unit plate and then turned over to Kennedy for PFRAM installation. The plate was shipped back to LaRC and used to verify the fabrication and assembly method of the PFRAM interface.

Optical Payload for Lasercomm Science (OPALS)

The OPALS payload was shipped from JPL and arrived at the SSPF on July 11, 2013. Kennedy supported JPL's health and functional checks of the payload prior to connecting to the Payload Rack Checkout Unit/ELC Simulator (PRCU/ELC Sim) that emulates the space station interfaces in orbit. A complete end-to-end interface verification test that included checks of power quality, commanding and telemetry was performed on the fully assembled OPALS payload. OPALS was delivered to Launch Complex 40 at CCAFS for SpaceX-3 launch integration.

Bigelow Expandable Activity Module (BEAM)

BEAM is a technology demonstrator project to show the benefits of flying expandable modules, rather than full-size aluminum modules, into space. BEAM will launch on a future SpaceX flight for a two-year demonstration berthed to the space station. To assist in forming new partnerships and encouraging technology transfer from NASA to commercial use, Kennedy performed leak tests on two spare Multi-Purpose Logistics Module intermodule ventilation valves that will be



Dr. Howard Levine, chief scientist in NASA's International Space Station Ground Processing and Research Project Office, watches as Michele Koralewicz of QinetiQ North America assembles a Biological Research in Canisters, or BRIC, experiment package.



In the Space Station Processing Facility, engineers prepare to load experiments requiring low temperatures into the General Laboratory Active Cryogenic International Space Station Experiment Refrigerator (GLACIER) on Feb. 26, 2013.

Center to develop the requirements for a preliminary design review. New requirements were identified and included in the design before proceeding to a Critical Design Review. The APH is targeted to become fully operational on the space station in 2015.

Advanced Plant Experiment on Orbit (APEX-02-1, APEX-02-2 and APEX-03)

The APEX payload series is intended to perform studies of biological systems in the spaceflight environment. APEX-02-1 and APEX-03 will attempt to gain an understanding of physiological processes, such as gene expression, metabolism and general development, that are affected in plant seedlings exposed to microgravity. Both are scheduled to launch aboard the SpaceX-5 mission to the space station. APEX-02-01 and APEX-03 utilize petri plates containing Arabidopsis seeds that will be inserted into the Veggie

loaned to the Bigelow Expandable Activity Module project.

NASA Research Announcements

The ISS Research chief scientist at Kennedy participated in the selection of NASA research proposals for the center. They include five plant ground study proposals and two plant spaceflight proposals. The chief scientist also supported the announcement of NASA Plant Biology and Microbiology Research proposal reviews targeting the use of Biological Research in Canister-Petri Dish Fixation Units (BRIC-PDFUs), Advanced Biological Research System and Veggie.

Plant and Microbial Research

Kennedy manages the Advanced Plant Habitat facility class rack, Advanced Plant Experiments (APEX) series, Biological Research in Canisters (BRIC) series, BioTube series, REALTIME DNA and Veggie facility for NASA's Space Life

and Physical Sciences Research and Applications Division.

Advanced Plant Habitat (APH)

The APH is a new plant growth facility that, when completed, will be one of the largest by volume and area for growing plants on the space station. The habitat is a joint effort between NASA and Orbital Technology Corp. in Madison, Wis.

Kennedy's APH design team successfully resized the APH to fit space station requirements. Kennedy worked with NASA Headquarters and Johnson Space



The Optical Payload for Lasercomm Science, or OPALS, experiment is unpacked in a test cell at a Space Station Processing Facility offline laboratory at NASA's Kennedy Space Center on July 11, 2013.



Engineers prepare experiments Feb. 27, 2013, for loading aboard the SpaceX Dragon capsule for launch to the International Space Station.

hardware where the seeds will germinate and grow for different lengths of time prior to fixation and return to Earth for analysis. APEX-02-2 is a yeast experiment that will fly on SpaceX-3 in April 2014, and will utilize the NanoRack Plate Reader hardware to investigate yeast gene regulation in space. The Kennedy team performed both Science Verification and Payload Verification Tests on each of these three experiments.

Biological Research in Canisters (BRIC-17)

BRIC-17 was launched aboard SpaceX-2. All four BRIC canisters were successfully actuated during the mission. To prepare them for the mission, Kennedy completed several payload readiness tests and reviews. During the mission, the canisters were actuated and inserted in the Minus Eighty-Degree Laboratory Freezer for ISS (MELFI), where they remained until just

prior to SpaceX's Dragon capsule undocking from the station. MELFI is a cold storage unit that maintains experiment samples at ultra-cold temperatures throughout the mission. The canisters were returned to the principal investigators for post-flight analysis.

Biological Research in Canisters (BRIC-18)

NASA's Space Life and Physical Science Program (SLPS) approved BRIC-18 to proceed from definition study (partial funding) to flight status (full funding). Kennedy conducted the Delta Science Verification Test on BRIC-18 canisters. A payload verification test was performed to support their delivery to the space station on the SpaceX-3 mission in April 2014.

Biotube

Biotubes are designed to carry plant samples to the space station to study the potential need for magnetic fields to orient the plant roots as they grow in microgravity. Results from Biotube research may lead to using high-strength magnetic fields in space to help grow food during long-duration missions. Several key milestone tests in the certification process were met this year, including electromagnetic interference, pressure certification, off-gas and payload readiness checkout. Three Biotube magnetic field chambers, each containing eight seed cassettes,

are scheduled for delivery to the space station on the SpaceX-3 mission in April 2014.

REALTIME DNA (RTDNA)

The team successfully participated in a parabolic flight in February using FastRack and RTDNA. The primary goal was to validate the operation under microgravity conditions of a RTDNA prototype unit targeting deployment on the space station. Testing verified that the temperature was sufficiently stable during zero gravity exposures.

Veggie

Veggie is an expandable plant growth chamber designed to fit within an EXPRESS rack on the space station. The chamber will be flown to the station on the SpaceX-3 mission in April 2014. Veggie will be used to conduct a functional crop test with increased growing volume. Engineers at Kennedy and Marshall Space Flight Center in Huntsville, Ala., successfully completed electromagnetic interference testing, PRCU/Flight Calibration Unit testing and off-gas testing. Scientists and engineers completed final payload verification and validations testing of the integrated Veggie System at Kennedy by growing a crop of red lettuce.

An acceptance review meeting was conducted, and final turnover of the Veggie units from the manufacturer ORBITEC of Madison, Wis., to NASA was completed. The Veggie flight hardware was shipped to Johnson and loaded into the Dragon for the March launch.

Veg-01

Veg-01 will be the science used in the technical demonstration flight for Veggie. The team tested the root-mat pillows to be used in the experiment. The experiment is currently manifested for SpaceX-3.

Logistics

Kennedy's logistics team ensured the timely delivery of numerous ORUs, payloads, ground support equipment and post-flight experiments, including the multi-filtration beds shipped to Johnson Space Center in Houston for the Automated Transfer Vehicle 5 mission to the space station, a payload interface unit to support the ISS-Cosmic Ray Energetics and Mass (CREAM) payload integration, and the return of payload shipping containers from the HTV-4 mission and Biologic Research in Canisters-17 (BRIC-17) hardware.

Kennedy was designated by the ISS Program to receive and warehouse station assets slated for turnover from original equipment manufacturers. Assets include flight materials (parts, assemblies and raw materials that were determined to have future use) and residual equipment (flight support equipment, ground support equipment, test equipment and tooling).

The Kennedy team worked with program logistics to develop property management techniques to meet Federal Acquisition Regulation (FAR) requirements while minimizing costs. For example, Kennedy shipped one of three Express Transportation Racks to Marshall Space Flight Center to support the development of a new space station galley rack that will launch aboard an HTV and be installed in Node-1 on the space station.

SSPF Science Annex

NASA's Human Exploration and Operations Mission Directorate made the decision to accelerate and proceed with Phase 2 of the SSPF Science Annex at Kennedy to meet requirements for the SpaceX-4 flight. The Rodent Habitat preliminary design review occurred in November 2012, and requirements for the science annex were finalized. Cape Design Engineering began Phase 1 site preparatory work in June 2013 with an estimated completion date of May

2014. The annex meets the standards of the American Association for the Accreditation of Laboratory Animal Care.

Strategic Initiatives

Kennedy signed a one-year lease with Micro Aerospace Solutions for the use of office and laboratory space in the SSPF. The office continued to explore partnership collaborations and agreements with commercial entities interested in the SSPF assets. ✨

The Space Exploration Technologies (SpaceX) Falcon 9 rocket lifts off Space Launch Complex 40 on Cape Canaveral Air Force Station in Florida on March 1, 2013, carrying a Dragon capsule filled with cargo to dock for the first time with the space station on the SpaceX-2 mission.



ENGINEERING & TECHNOLOGY

Every step taken by Kennedy Space Center's Engineering and Technology Directorate keeps NASA on the cutting edge of technology development -- and helps to secure our future in space exploration.

When humans venture into deep space on future long-duration spaceflights, self-sufficiency will be a necessity. Closed-loop life support systems on such journeys will require innovative ways of supplying food.

Engineers and scientists at Kennedy are conducting plant growth research and experiments to better understand and address the unique challenges associated with growing plants in a space environment. During FY 2013, the directorate partnered with other NASA field centers, academia and industry on a variety of plant-growth efforts. Using a combination of ground-based and International Space Station flight-based experiments, these projects are investigating the effects of lighting conditions, water distribution systems, and germination and nutrient distribution techniques, as well as the potential for magnets to simulate gravity. Kennedy engineers are providing expertise in design and development, payload processing and operations,

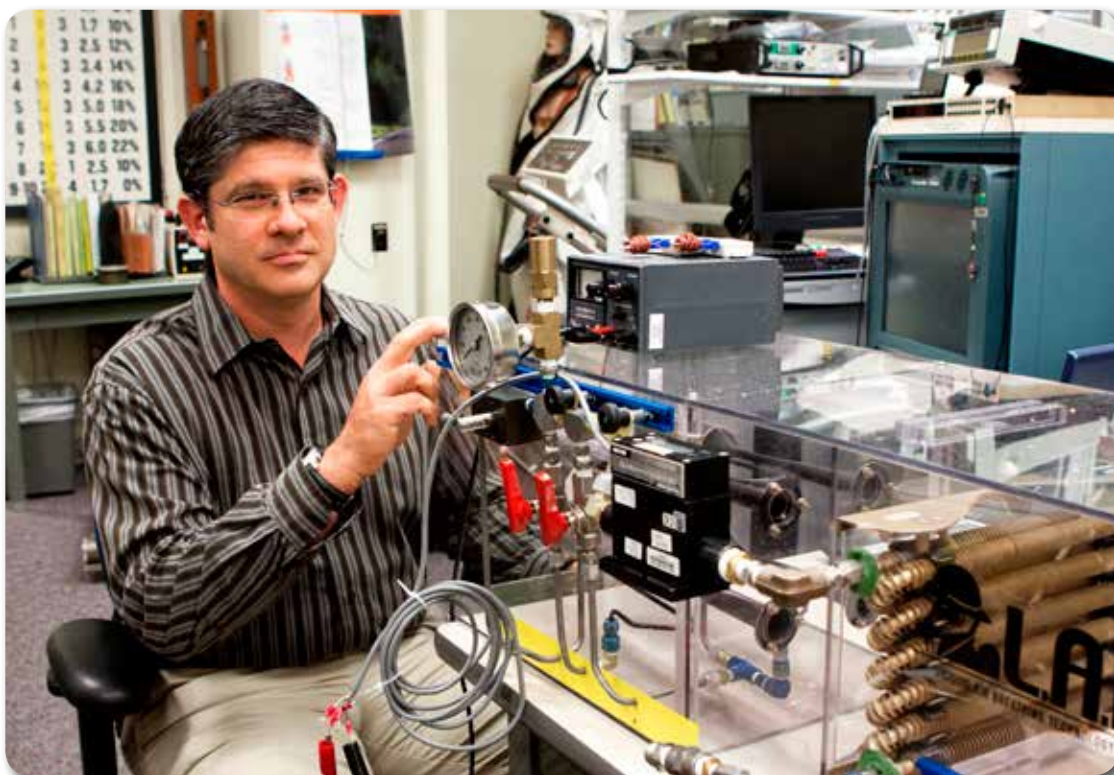
project management, and more to help ensure mission success.

Waste management is another important aspect of the life support system on a long-duration mission. International Space Station residents can store waste on board, send it back to Earth on a return mission, or release it to burn up in Earth's atmosphere. But future crews aboard faraway spacecraft won't have these options and will rely instead on in-situ resource utilization systems. Through Trash-to-Gas technologies dealing with waste as a potential resource, stabilizing it and minimizing the volume to be stored, Kennedy engineers have studied gasification, pyrolysis and incineration

with development of first- and second-generation trash reactors, as well as characterization of waste simulant and reactor properties.

While maintaining a focus on the needs of future space explorers, the directorate also is helping to prepare the space center's infrastructure for the vehicles slated to fly those crews: the Space Launch System (SLS) rocket and the Orion multi-purpose crew vehicle.

The directorate is assisting the agency's Ground Systems Development and Operations (GSDO) Program in the design of critical launch-pad ground support equipment for the SLS program.



NASA Kennedy Space Center lead engineer David Bush works on a prototype of a Cryogenic Refuge Alternative Supply System, or CryoRASS, in the Operations and Checkout Building on June 19, 2013.



On June 21, 2013, students from the University of Colorado describe a robotic capability for growing a variety of plants, both for consumption as well as the benefit of oxygen-carbon dioxide cycling at Kennedy. Considerations range from monitoring and nutrient supply to selection of plants and autonomy.

Seven umbilical subsystems range in complexity from simple T-0 disconnects to hydraulically actuated swing-arms, while the vehicle stabilizer will prevent the rocket from swaying due to wind conditions. The crew access arm resembles the design of the same swing-arm used for the Saturn rocket and even shares some of the same components.

Two new work stands under construction in Kennedy's Multi-Payload Processing Facility will support Orion hazardous propellant operations. The servicing stand offers motorized flip platforms for 360-degree access and the deservicing stand will provide access to returning vehicles. Both stands are compatible with ground support equipment developed by Lockheed Martin, the prime contractor building Orion.

Development of any new space vehicle or related system calls for testing in a realistic environment. The new Customer Avionics, Interface Development and Analysis Laboratory answers this need by offering avionics customers an array of services, including design and verification of ground-to-spacecraft command and

control interfaces, testing of operational procedures, simulation and emulation development, and specialized training. The laboratory features flight-equivalent Orion avionics hardware and software, with plans to add SLS emulation in support of GSDO.

Kennedy's Engineering and Technology Directorate also continues to drive the development of technologies for the future exploration of terrestrial worlds. The Regolith Advanced Surface Systems Operations Robot, also known as RASSOR (pronounced "Razor"), is designed to mine resources in a number of different locales in the solar system. The directorate's efforts to convert the robot's chassis from aluminum to a more lightweight composite led to a redesign of the existing chassis.

Future robotic explorers won't be limited to smooth terrain, thanks to technologies such as the Extreme Access flyer project in Kennedy's Granular Mechanics and

Regolith Operations Laboratory, better known as the "SwampWorks." The Extreme Access flyer will provide the capability to collect data and soil samples from areas with terrain or topography too challenging for surface rovers. The directorate is contributing to this effort by designing the XTREME Access Sample Acquisition System, a suite of small devices to fly aboard the robotic flyer and collect small soil samples upon landing at a site of interest.

Toughened Uni-piece Fibrous Reinforced Oxidation-resistant Composite, or TUFROC, is a new composite material for spacecraft thermal protection. Developed at NASA's Ames Research Center in California, TUFROC is a dimensionally stable material suitable for re-entry vehicle nose caps, wing leading edges and control surfaces. The Engineering and Technology Directorate is working in tandem with GSDO to bring the technology to Kennedy's existing Thermal Protection Facility for manufacturing.

After decades of designing and operating robots full of scientific gear to study other worlds, NASA is working on a prototype, dubbed RASSOR, for Regolith Advanced Surface Systems Operations Robot, that leaves the delicate instruments at home in exchange for a sturdy pair of diggers and the reliability and strength to work all day, every day for years.

Under an initial agreement with Ames, Kennedy will fabricate the material's top layer, known as Refractory Oxidative-resistant Ceramic Carbon Insulation.

Storage and loading of chilled propellants, called cryogenics, is an ongoing challenge the directorate is working to advance. Two ground operations demonstration units, the Integrated Refrigeration and Storage (IRAS) and Autonomous Control, were built to mature, integrate and improve the current state of the art in the areas of cryogenics, system health management and command-and-control technologies. The necessary hardware is installed for liquid hydrogen (LH2) and liquid oxygen (LOX) testing, and the team has demonstrated the autonomous filling of the 2,000-gallon LOX tank and used liquid nitrogen to verify the LH2 propellant storage and transfer system.

At the request of NASA's Marshall Space Flight Center in Alabama, the directorate also is leveraging Kennedy's expertise in cryogenics by developing a repair and evaluation process for composite tanks. This effort includes damaging and repairing new and existing test panels, then verifying the repairs using non-destructive evaluation methods.

Several other technologies in development at Kennedy have the



potential to improve the capabilities and affordability of future exploration.

The Site Test Interferometer (STI) is a suite of three small antennas constructed at NASA's Jet Propulsion Laboratory and installed in Kennedy's Industrial Area for the purpose of measuring the effects of atmospheric turbulence on space communication and radar signals. The STI will help determine to what degree the Ka Band Objects Observation and Monitoring (KaBOOM) System's signals are disrupted by such turbulence, while providing a measure of KaBOOM's atmospheric compensation process.

The directorate is working with GSDO to design and build the Deployable Launch System (DLS), a multi-user rocket test-and-launch capability for Kennedy. The new DLS launch mount is being designed to accommodate its first customer, the U.S. Army's 95-foot-tall Soldier-Warfighter Operationally Responsive Deployer for Space (SWORDS) rocket.

Kennedy engineers also have gained valuable experience in asteroid tracking and modeling. During a month of training

with experts at NASA's Jet Propulsion Laboratory in Pasadena, Calif., the Kennedy team tracked asteroids using the Goldstone 70-meter radar antenna and used specialized software to model the asteroids based on radar data. The team continued its training at Kennedy, using modeling simulations to determine the shape, pole direction, spin rate and surface characteristics of Asteroid 1862 Apollo.

Finally, the Engineering and Technology Directorate is helping to keep Kennedy's workforce on the cutting edge with Rocket University. Now in its second year, this comprehensive training and development program aims to enhance and maintain flight systems engineering skills and expertise through a combination of coursework and hands-on training. Participants this year checked off a wide range of accomplishments, including three balloon launches; fabrication, integration and testing on Genesis, the first composite aircraft designed in-house; and the flight of a CubeSat nanosatellite payload aboard the Garvey Prospector-18D rocket, launched from California's Mojave Desert. ✨

A heron stands in the waters of the Blackpoint Wildlife Drive in the Merritt Island National Wildlife Refuge, northwest of Kennedy on Dec. 19, 2012. The center shares a boundary with the Merritt Island National Wildlife Refuge. The marshes and open water of the refuge provide wintering areas for 23 species of migratory waterfowl.



CENTER OPERATIONS

The Center Operations Directorate at Kennedy continued to play a large role in 2013 in the spaceport's adaptation to a multi-user spaceport without sacrificing its day-to-day obligations. Major buildings and facilities were upgraded during the year to modernize the center's workplaces while unused structures were demolished in accordance with NASA goals.

The Operations & Checkout Building, the first structure built at Kennedy, completed a major makeover in 2013 that turned the 1960s-vintage interior and offices into a modern workplace. The multi-million-dollar reconstruction reduced maintenance costs, improved energy efficiency, and enhanced and modernized administrative space.

The directorate also completed the project design for the first phase of the central campus approach for the Kennedy Data Center that will enable consolidation of multiple data centers. The conceptual design phase for the Administrative Office and Shared Services Building, which will replace the existing Headquarters, also is complete. Construction is to begin in FY14.

Kennedy's transformation from a space shuttle-centric launch site to a multi-user spaceport calls for significant repurposing of numerous buildings and facilities, and Center Operations continues to work through this process that includes new NASA programs and commercial entities. Various other facilities and infrastructure for which there is no future need are being demolished. About 54,000 square feet of facilities were demolished this year, and plans to remove an additional 100,000 square feet over the next couple of years are well underway. Shrinking the center's "footprint" has become a key strategic initiative, as Kennedy strives to become more sustainable to meet future mission needs.

Environmental Sustainability

The space center is the agency leader in

the environmental sustainability initiative. Having released the agency's first center-level sustainability plan in FY12, Kennedy moved robustly into the implementation phase this year.

The center partnered with the Air Force's 45th Space Wing to destroy 33 excess space shuttle and Ares-1X solid rocket booster separation motors at Kennedy's landfill using an innovative, environmentally-friendly approach that saved NASA about \$300,000 in off-site shipping and disposal costs.

Kennedy's compliance with stringent federal, state, and local environmental regulations is impeccable. External regulatory agencies conducted formal environmental compliance inspections at the center in the areas of hazardous waste, landfill compliance, petroleum storage tanks, storm water management,



Two ducks are reflected in the waters off Blackpoint Wildlife Drive in the Merritt Island National Wildlife Refuge, north of Kennedy Space Center.



Becky Bolt, a wildlife ecologist with InoMedic Health Applications Inc. at Kennedy, holds a rescued eaglet. When a strong thunderstorm blew through the center March 24, 2013, two eagles fell to the ground along with their nest.

industrial wastewater, and septic systems with no significant findings or violations.

Kennedy opened the Pathfinder Fitness trail in 2013. Constructed out of recycled materials and volunteer efforts, the track is named in honor of the first space shuttle orbiter test vehicle and is shaped in the outline of an orbiter.

The exercise equipment stations are made with recycled content, making this fitness trail even more sustainable. This project also addressed the center's sustainability goal of workforce satisfaction.

Through strategic investments as well as increased employee awareness, Kennedy exceeded the 24 percent reduced energy intensity goal, as required by the Energy Independence and Security Act (EISA). The center's energy intensity in the goal-subject facilities is trending at 3 percent reduction per year as compared to a 2003 baseline. As a result of major utility system upgrades, Kennedy's potable water consumption intensity also has reduced by 12 percent as compared to a 2007 baseline.

The space center met executive order goals and agency objectives in waste

diversion through innovation and creative engineering. Kennedy diverted 50 percent of solid waste through reuse or recycling. These initiatives also led to diverting 50 percent of solid waste generated by construction activities, amounting to several thousand pounds of materials that did not go into a landfill.

A Sustainability Fair was held to mark Earth Day at the KSC All-American Picnic to promote green and sustainable products and services for commercial and residential use. Twelve vendors provided useful information at the fair. Kids participated in a scavenger hunt called "Green-a-teering," which was designed to educate about environmental efforts.

Kennedy's various recycling efforts continue to increase over time. For America Recycles Day, Kennedy collected 6,514 pounds of electronic waste that employees brought from home. As a result of 21st century modernization projects, Kennedy diverted about 35,000 pounds of copper cable from the center's landfill. Kennedy also completed a successful 90-day alkaline battery recycling pilot program, collecting about 900 pounds of spent batteries, which resulted in instituting an alkaline battery recycling program.



One of the most destructive storms ever to hit the United States, Hurricane Sandy bashed the beaches of Brevard County in late October 2012, including the shoreline of Kennedy Space Center. Scientists are assessing damage along a 1.2-mile stretch of shoreline near Launch Pads 39A and 39B and developing restoration plans.

Propellants Support to Morpheus

The Kennedy propellants team played a key role in supporting the Morpheus Prototype Lander project. This project presented the opportunity for NASA engineers to gain hands-on experience by performing all aspects of cryogenic and high-pressure gas propellant transfers from vendor deliveries, as well as loading these commodities into the Morpheus vehicle. These civil service engineers completed required course work, medical examinations and on-the-job qualification training on nine cryogenic and high-pressure gas operations procedures. Meeting a very aggressive schedule while trying to minimize project costs, the team quickly performed analyses, created designs and drawings, wrote procedures, initiated procurements, modified and activated propellants equipment and even helped to construct the Morpheus hazard field at the north end of the Shuttle Landing Facility.

Protective Services

Kennedy's Emergency Response Team (ERT) continues to showcase superior

tactical skills and readiness that are among the best in the world as evidenced by their third place finish in the 30th Annual S.W.A.T. Round-Up International event. This prestigious event featured 51 domestic and international agencies, competing among the best special operations teams in the world.

Kennedy also is home to the NASA Protective Services Training Academy (NPSTA), which provides agencywide federal law enforcement training. In 2013, NPSTA instructors conducted federal arrest authority and security officer fundamental certification classes at six different NASA centers. A High Risk Conflict Resolution (HRCR) course was developed for the entire NASA workforce and focuses on identifying, reporting and reacting to workplace violence situations. Adding to NPSTA's many unique training tools, Kennedy activated a new precision rifle range to ensure officers are proficient in long-range accuracy and offers a unique opportunity to partner with other federal, state, military and local law enforcement agencies. In the area of fire protection service, the Pro Board Fire Service Professional Qualifications System granted accreditation to NASA's

training and certification program, which enables NPSTA to provide nationally accredited training to fire rescue personnel agencywide.

Kennedy Spinoffs to Enhance Mine Safety

During FY13, Kennedy entered into a partnership with the National Institute of Occupational Safety and Health (NIOSH) to advance the use of cryogenic life support technology beyond Kennedy's boundaries. Leveraging unique technology developed for the Space Shuttle Program, as well as other new innovations, the center is applying these capabilities to potential new mine safety and rescue equipment. The technology also will be applicable to future astronaut rescue efforts.

Space Shuttle Excess Property

Following the Space Shuttle Transition and Retirement activities, Kennedy processed 237,109 line items through the property disposal process. The center also transferred another 249,964 line items to successor contracts, other NASA centers and other federal agencies. Total Kennedy transactions amounted to double that of all other NASA centers combined. Many historical artifacts also were sold or donated to museums, sharing the NASA story throughout the country. ✨



Amy Mangiacapra of Jacobs Technology, left, and Frank Klein, of NASA's Environmental Management Branch, load electronic products for recycling in the Vehicle Assembly Building parking lot during an electronics collection event.



In the Mojave Desert in California, students and engineers check out the Garvey Spacecraft Corp.'s Prospector P-18D rocket at the Friends of Amateur Rocketry launch site on June 14, 2013. The rocket carried four satellites made from four-inch cube sections when launched the next day. Collectively known as CubeSats, the satellites were built by different organizations, including a university, a NASA field center and a high school.

EDUCATION

Kennedy Space Center's Education Office pursued multiple avenues to share NASA's and the center's stories with the public, educators and students. It also inspired and engaged thousands through enriching educational programs, internships and partnerships.

Team members managed agencywide programs, formed strategic partnerships, and hosted and supported educational, family-oriented events with the goal of promoting science, technology, engineering and mathematics -- the STEM disciplines -- to every student or teacher who crossed their paths.

Kennedy hosted 72 college- or university-level interns and reached 56,749 K-12 students and teachers through formal educational programs such as rocketry workshops at Kennedy's Exploration Station, NASA Schools Connection for low-performing local middle schools and the Digital Learning Network programs, which frequently featured Center Director

Bob Cabana. The team also assisted during the much-anticipated annual Brevard Space Week. Organized by Delaware North Parks & Resorts and the National Space Club Florida Committee, the event allows sixth-grade students in Brevard County to relive humanity's voyage into space by investigating exhibits, taking part in the Shuttle Launch Experience and meeting an astronaut at the Kennedy Space Center Visitor Complex.

Projects that Kennedy manages for the agency are Experiment Program to Stimulate Competitive Research (EPSCoR), Minority University Research and Education Programs (MUREP) Small Projects (MSP), and Interdisciplinary Science Project Incorporating Research and Education (INSPIRE). Kennedy also jointly oversees the Motivating Undergraduates in Science and Technology (MUST), and Summer of Innovation programs with NASA's Glenn Research Center.

NASA Education funded 14 new and exciting EPSCoR research projects for a maximum of \$750,000 each for a period of three years totaling \$10,466,822, and funded year two of the 2012 Research Infrastructure Development grants at approximately \$125,000 each for a total of \$3,624,673.

Minority Innovation Challenges Institute (MICI), an MSP grantee managed by Florida Agricultural and Mechanical University (FAMU), supported the participation of 13 minority-serving institutions in NASA challenges. Currently, 289 faculty and 1,401 students are enrolled in MICI, representing 489 colleges, including 142 minority-serving institutions. In 2013, MICI hosted two virtual career fairs, reaching 84 students from 46 universities across the country. Career exhibitors included NASA field centers, agency contractors and aerospace companies. Another MSP grantee project that Kennedy manages, called Achieving Competence in Computing, Engineering and Space Science (ACCESS), placed 33 students with disabilities into internships at NASA's 10 centers. Four of those students were placed at Kennedy.

During the fourth annual NASA Mining Competition, Kennedy welcomed 500 students from the U.S. and seven



On May 10, 2013, students from Merritt Island High School in Florida perform integration tests on an instrument package called StangSat they will fly on a suborbital mission. The StangSat will work inside a small rocket to measure vibration and other data during launch.



At the Kennedy Space Center Visitor Complex, Camp Kennedy Space Center participants get an up-close look at the space shuttle Atlantis on June 21, 2013, during a weeklong summer activity for students entering second through ninth grades.

2012, Space Shuttle Atlantis Grand Opening in June 2013, Kennedy's Fall Festival, Universal Studios STEM Day, Florida Astronaut Challenge, Women in Aviation, Sun 'n Fun Airshow, NASA Family Day, STAR 94.5 Cares Day and the Tom Joyner Family Reunion.

countries. The five-day event is for university-level students who have designed and built an autonomous excavator. The competition involves mining and depositing a minimum of 10 kilograms of regolith simulant within 10 minutes.

The Kennedy Education staff engaged an additional 79,926 teachers and students through less formal, family-oriented activities throughout the year providing hands-on activities and workshops through partnerships with nationally recognized youth organizations and service groups, including the Boy Scouts,

4-H student and leader groups, Girl Scouts, Delta GEMS, Florida Challenger Learning Centers, Camp Boggy Creek, Cub Scouts, Tech Sassy Girlz, Space Coast Jr./Sr. High STEAM Academy, Girls Get IT, and Navy and Air Force Youth Center/Afterschool groups, to name a few.

Kennedy also created a year long, monthly workshop program in partnership with several local Boys and Girls Clubs called the Saturday Academy in an effort to engage underserved, underrepresented populations. Kennedy hosted a NASA Night for Dreamflight, a group of seriously ill and disabled children from the United

The Education Office also hosted several groups from Japan's Super Science High Schools, Family Nights at local schools, and partnered with Florida's Department of Education for a Back to School Night at a local school.

In an effort to continue building relationships with Minority Serving Institutions and providing NASA managers with insight into the institutions' technologies and the students' capabilities, NASA Days at Minority-Serving Institutions were held at Florida A&M University, Prairie View A&M University, Jackson State University, Florida International University and Navajo Technical College. Several organizations at Kennedy supported these multiday events. One-Stop-Shopping-Initiative (OSSI) and Pathways briefings were held in conjunction with hands-on computer workshops for the students. The events concluded with center managers interviewing students for potential OSSI and Pathways opportunities. As a result of these events, the Kennedy student internship pool increased its diversity. 🌟

Kingdom, allowing them experiences that had never before been possible.

The Education staff participated in public outreach events, including the Atlantis rollover in October



Middle and high school students from Florida's Putnam and Volusia counties use a bicycle wheel as a gyroscope to simulate principals of motion during a science demonstration at NASA's Center for Space Education at Kennedy Space Center on March 29, 2013.

OUTREACH TO THE WORLD

The work performed at NASA's Kennedy Space Center drew interest from around the world in 2013 as people turned to traditional media and the increasingly depended-upon Web and social media sites to find out new details about Kennedy research and operations.

The center continues to make headlines for launching missions to explore Earth and other planets, new flights to resupply the International Space Station, and exciting research focused on several aspects of exploring distant worlds.

The center's appeal also expanded during 2013, primarily through the opening of the one-of-a-kind exhibit for space shuttle

Atlantis at the Kennedy Space Center Visitor Complex operated by Delaware North Parks & Resorts.

News Media Operations

American and worldwide news media continued to look toward Kennedy for launch and mission events during 2013.

The news center at the Florida spaceport continued to adapt to the needs, abilities and expectations for a rapidly changing and diversifying media. Missions to deliver scientific experiments and cargo to the International Space Station, along with a launch to place a new piece in NASA's network of communications satellites, offered reporters, photographers and specialist bloggers engaging subjects to

share with their audiences in the form of in-depth written and televised features, short status reports about mission preparation and minute-by-minute updates on launch countdowns.

Topics also included new research ongoing at Kennedy, such as the work

Dr. Thomas Loveland, senior scientist and co-chair of the Landsat Science Team U.S. Geological Survey Earth Resources Observation and Science Center, left, and Dr. Jim Irons, Landsat Data Continuity Mission project scientist from NASA's Goddard Space Flight Center, speak to NASA social media followers at Vandenberg Air Force Base, Calif., on Feb. 10, 2013, prior to the launch.



Kennedy Space Center Director Bob Cabana spoke to students at Cobb Middle School in Tallahassee, Fla., on March 6, 2013, during his visit to the Capitol for Space Day activities.



by the center's SwampWorks Lab to develop robotic vehicles that can explore distant worlds. Futuristic subjects have long grabbed audience's imaginations and, judging by media interest, continue to do so.

Kennedy's Public Affairs Directorate met this interest and the journalists' needs with live and taped interviews, news conferences, media updates, fact sheets and newsletters. These traditional outlets were enhanced with the continued use of social media, websites and blogs to share information.

Kennedy Television continues to broadcast high-definition productions of launches, conferences and events, along with streaming video. The center offers digital images in its one-of-a-kind multimedia gallery and operates a full-service office focused on professional journalists.

NASA's future plans continue to raise interest from the public, and the Public Affairs Directorate helped tell the NASA story by distributing still photos and videos, tapes, CDs and DVDs to media outlets.

Kennedy Web Presence

The Kennedy Space Center website continued to draw a worldwide audience during 2013. The center's home page at <http://www.nasa.gov/kennedy> attracted close to 15 million views, outpacing the performance of other NASA centers, government agency websites and many commercial sites.

The Kennedy Web team detailed the delivery of NASA's space shuttle Atlantis to its final destination, the Kennedy Space Center Visitor Complex, to be on permanent display and was highlighted for the public at <http://www.nasa.gov/centers/kennedy/shuttleoperations>.

Kennedy's social media presence, under the username NASAKennedy, became a standard for many to find out the latest news from the space center, increasing the fan base to more than 300,000 likes on Facebook, and roughly 500,000 followers on Twitter. YouTube climbed to more than 31,000 subscribers with more than 4 million video views.

During the year, the Web team provided launch processing and countdown coverage for three expendable launch vehicle missions: Tracking and Data Relay Satellite-K, Landsat Data Continuity Mission and Interface Region Imaging Spectrograph, along with a SpaceX resupply mission to the International Space Station. An international Internet audience was kept up-to-date during countdowns and landings with frequent updates to the mission's main page along with photo and video galleries.

NASA's Launch Blog provided live commentary and up-to-the minute information straight from a control room console to readers. Kennedy's Web video products included feature videos and podcasts, as well as highlights of launches and landings.

The Web team wrote and published more than 80 Web features and assisted with the publishing of more than 125 Web videos.

Government Relations

Kennedy Space Center Director Bob Cabana spoke to Space Coast leaders during the year and joined industry representatives at the state capital in Tallahassee to visit with state legislators during Florida Space Day.

Cabana met with members of the Florida Congressional Delegation in Washington, D.C., in support of NASA's Office of Legislative and Intergovernmental Affairs annual "Day on the Hill" and shared Kennedy's plans and activities with the Brevard legislative delegation. Kennedy's senior management team participated in numerous forums and meetings throughout Florida concerning



NASA's Jon Cowart talks to media in Kennedy Space Center's Press Site about the progress of the agency's Commercial Crew Program (CCP) and its partners on Feb. 28, 2013.

the future of the center and the space industry.

Elected officials from federal, state and local levels toured Kennedy facilities to learn more about the wide range of activities happening at the center in 2013, including the three programs headquartered at the center. They also attended SpaceX launches, the launch of TDRS-K from Cape Canaveral Air Force Station, shuttle Atlantis' move from the Vehicle Assembly Building to the Kennedy Space Center Visitor Complex, and the grand opening of the Atlantis exhibit at the visitor complex.

Kennedy Space Center Visitor Complex

Space shuttle Atlantis became a showcase attraction and educational star at the visitor complex in 2013 as the history-making spacecraft took its place inside the massive Space Shuttle Atlantis exhibit hall.

Anchored onto support structures that hold the orbiter at a 43.21-degree angle, Atlantis has proven a breathtaking sight to thousands of visitors who have seen the shuttle and its one-of-a-kind exhibit since it opened in June. The shuttle is depicted as it looked flying through space with its cargo bay doors open and robotic arm extended.

A full-scale Hubble Space Telescope model and large representations of the International Space Station help complete the space shuttle story, along with some of the ground support equipment built and operated at Kennedy to launch the spacecraft safely.

Workers moved the shuttle from the Vehicle Assembly Building to the visitor complex on Nov. 2, 2012, during a daylong procession that saw opportunities for NASA civil service and contractor employees and their families to see the shuttle that made the last flight of the program.

The shuttle exhibit is the largest feature of its kind at the visitor complex since the Apollo/Saturn V Center opened in 1996. Standing 184 feet high, a full-scale external tank with two solid rocket boosters forms a high-tech archway near the entrance.

A new entrance to the visitor complex was unveiled in December, which features a grand plaza and fountain, new ticket booths, a retail shop and the Rocket Garden Cafe.

The first Angry Birds interactive exhibit in the United States opened in March at the visitor complex. The attraction includes stations designed to encourage guests of all ages to enjoy learning about science, technology, engineering and mathematics through innovative ways, such as investigating the trajectory of the Space Pigs. Astronaut Don Petit who utilized Angry Birds while in space to explain scientific concepts was on hand for the opening.

How much the Space Shuttle Program meant to the team who worked on it was captured in a time capsule filled with various representative items. Encapsulated in a vault inside the Atlantis facility, it will not be opened until 2061 by Space Exploration ambassadors.

The visitor complex continued to tell the story of NASA's future endeavors,

including the Space Launch System and Commercial Crew Programs. Launch of uncrewed rockets or NASA, commercial and military rockets has been widely publicized, and great viewing opportunities were offered to the public at the visitor complex and the Apollo/Saturn V Center.

Celebrations were hosted for the 40th

anniversary of Apollo 17 and the Skylab missions, the Astronaut Autograph and Memorabilia Show and an Astronaut Hall of Fame Induction ceremony in which all three of the astronauts inducted had flown aboard Atlantis.

Display Management Team

The Display Management Team supported 51 events that reached out to more than half a million people. The events took place in four regions of Florida. The team also supported several nationwide agency events. In all of the outreach efforts, the Display Management Team focused on educating the public about Kennedy Space Center's future missions and programs and how NASA technologies impact the lives of people on Earth every day.

Speakers Bureau

Kennedy's extensive network of professional engineers, technicians and other aerospace experts took part in the center's speakers program. They attended more than 270 events throughout Florida, Georgia, Puerto Rico, and even as far away as Norway and Trinidad. They reached more than 48,000 children and adults through career days, science fairs, community events and professional talks. Kennedy employees reached an additional 50,000 people through 300 other outreach opportunities. ✨

On March 22, 2013, NASA astronaut Don Pettit uses a giant slingshot to launch a plush Angry Bird character during the grand opening of the new Angry Birds Space Encounter at the Kennedy Space Center Visitor Complex.



During opening ceremonies on June 29, 2013, for the new 90,000-square-foot Space Shuttle Atlantis facility at the Kennedy Space Center Visitor Complex, Expedition 36 flight engineers Karen Nyberg, left, and Chris Cassidy speak to guests via television from the International Space Station.

KENNEDY BUSINESS REPORT

Budget Highlights

The Kennedy Space Center Fiscal Year 2013 budget was nearly \$1.8 billion. The center also performed \$114.5 million in reimbursable work with other government and commercial entities.

The Commercial Crew Program (CCP) partnered with multiple aerospace companies in FY 2013, investing \$476 million to advance the development of crew space transportation systems for future missions to low-Earth orbit, including to the International Space Station (ISS). Space Act Agreements and the Certification Products Contract are enabling CCP's partners to work through paid-for-performance milestones to complete their designs, test their hardware, and then showcase how they would operate and manage missions from launch through orbit and landing.

The Launch Services Program (LSP) executed a \$416 million budget, both direct and reimbursable. LSP supported four successful mission launches: Tracking and Data Relay Satellite-K (TDRS-K) from Cape Canaveral Air Force Station in Florida, Landsat Data Continuity Mission (LDCM) and Interface Region Imaging Spectrograph (IRIS) from Vandenberg Air Force Base in California, and Lunar Atmosphere and Dust Environment Explorer (LADEE) from Wallops Flight Facility in Virginia. The program also procured launch vehicle services and other support for several manifested missions scheduled to launch in FY 2014 and beyond.

The Ground Systems Development and Operations (GSDO) Program budget of \$372 million supported Exploration Ground Systems content and 21st Century Space Launch Complex

initiatives. It provided for the modernization and augmentation of current and future ground systems design, development and ground operations infrastructure to support human exploration programs such as the Space Launch System and Orion, as well as future customers and stakeholders, including other government agencies and commercial users. Key projects included enhancements to the mobile launcher structure, Launch Complex 39B, payload processing facility and horizontal take-off and landing capabilities.

The ISS Program provided \$71 million in budget to the Kennedy Space Center, which allowed for continued success toward achieving and maintaining the ISS program mission of fully utilizing a permanent human outpost in space. Kennedy mission efforts afforded provisions for ground processing support for experiment hardware, as well as orbital replacement units needed to maintain the ISS. In addition, the budget provided for ongoing development of hardware intended to promote full utilization of the ISS through the establishment of fundamental biological research capabilities.

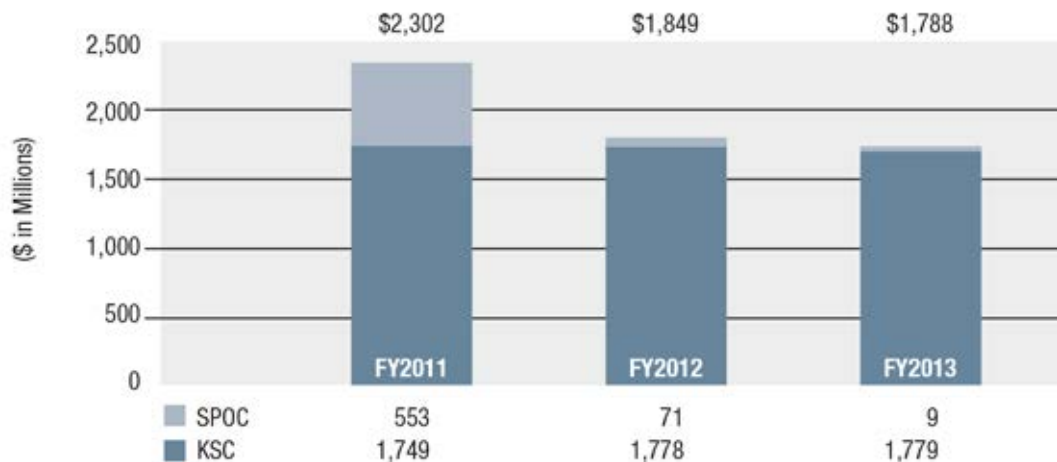
Kennedy's Center Management and Operations (CMO) budget provided \$337 million to maintain the center's essential infrastructure, preserve its core technical capabilities, and sustain necessary safety and engineering technical authorities. The budget also allowed for the implementation of, and support to, select agency and center initiatives, while providing for critical underlying business and site systems required to enable current and future NASA missions. ✨

Kennedy Space Center FY 2013 Budget Authority (\$ in Millions)

Commercial Crew Program	\$476
Launch Services/Science	\$318
Ground Systems Development and Operations	\$372
Space Station	\$71
Center Management & Operations	\$337
Other	\$205
Total KSC*	\$1,779

* Excludes \$9 million for Space Flight Operations Contract (SFOC)

NASA/KSC Budget Authority Summary FY 2011 through FY 2013 (\$ in Millions)



FY 2013 KSC Budget by Elements (\$ in Millions)



WORKFORCE OVERVIEW

Kennedy Space Center is the most broadly based, complex and successful launch center in the world. Both NASA and contract personnel working at the center are essential to the success of Kennedy.

The workforce includes people with many skills who are dedicated to supporting the nation's space program and NASA's future explorations. To accomplish the agency's various missions, these individuals fulfill a multitude of tasks.

At the end of each year, the center takes a snapshot of its workforce. This picture includes all federal and contract

employees chartered to work for Kennedy. Other organizations, such as the European Space Agency and Patrick Air Force Base, have roles here but are not reflected in these numbers.

As of Sept. 30, 2013, the total Kennedy population was 7,864. This includes 1,994 NASA civil servants, 84 interns and students, 4,246 on-site contract employees and 308 off-/near-site contract employees. There were 1,030 tenants. The civil servant skill mix includes those in science, technology, engineering and mathematics positions and those in professional administrative and clerical positions. ✨

Kennedy Space Center Workforce Profile (through 9/30/13)	
Civil Servants	1,994
Interns and Students	84
Total Civil Servants	2,078
Civil Servant Skill Mix	
Scientific, Technology, Engineering and Mathematics	67%
Clerical and Professional Administrative	33%
On-site Contract Employees	4,246
Off-/Near-site Contract Employees (includes construction workers)	308
Total Contract Employees	4,554
Total Construction Employees	202
Total Tenants	1,030
TOTAL KSC POPULATION	7,864

PROCUREMENT REPORT

The companies listed below were some of Kennedy Space Center's top support contractors or launch services contractors in terms of dollars obligated in FY 2013. Following is a brief description of their work for the agency:

United Launch Services LLC

United Launch Services (ULS), a subsidiary of United Launch Alliance, brought The Boeing Company, Delta Launch Services Inc. and Lockheed Martin Commercial Launch Services together. ULS provided launch services to NASA using the Delta II and Atlas V vehicles under two of three existing multiple-award, indefinite delivery, indefinite quantity task order contracts. Principal location for the Delta II vehicle assembly is Decatur, Ala. Principal location for the Atlas vehicle assembly is Denver, Colo. Both vehicles launch from Cape Canaveral Air Force Station (CCAFS) in Florida and Vandenberg Air Force Base (VAFB) in California.

QinetiQ North America – Mission Solutions Group

QinetiQ North America – Mission Solutions Group (QNA) provided engineering products and services to Kennedy's Engineering and Technology Directorate and other center and agency operational customers. QNA provided laboratory and developmental shop

maintenance and operations, technical services, spaceflight systems engineering and engineering development. QNA also provided technology outreach to foster awareness and utilization of Kennedy's unique capabilities.

URS Federal Technical Services Inc.

URS Federal Technical Services provided base operations support for Kennedy. URS Federal Technical Services was responsible for operations, maintenance and engineering for specific Kennedy facilities, systems, equipment and utilities. URS Federal Technical Services also was responsible for calibration and propellants handling at the center.

Abacus Technology Corp.

Abacus provided communication and information technology services under the Information Management and Communications Support (IMCS) contract. Abacus supported the majority of these requirements at Kennedy, which included support to agency programs, payloads, launch services and the International Space Station. Services provided include hardware and software integration development, computer administration and maintenance, voice and data transmission, library, graphics, publications, printing and reproduction, and IT security.



The 525-foot-high Vehicle Assembly Building in the Launch Complex 39 area at Kennedy is one of the world's largest buildings by volume.

Jacobs Technology Inc.

Jacobs Technology Inc., prime contractor for the Test and Operations Support Contract (TOSC), is responsible for the overall management and implementation of ground systems capabilities, flight hardware processing and launch operations at Kennedy. Specific services provided by Jacobs Technology under TOSC included launch vehicle, spacecraft, and payload integration and processing; operations and development of associated processes for ground systems to support integration, processing and launch; servicing and testing of flight hardware; and launch of development and operational flights at Kennedy. Jacobs provides these services to meet NASA requirements, including support to the agency's programs, commercial entities and other government agencies as designated by the government.

Chenega Security & Support Solutions LLC

Chenega Security & Support Solutions LLC (CS³) teamed with G4Sgs as their subcontractor to provide protective services support for NASA at Kennedy under the Kennedy Protective Service Contract (KPSC). These comprehensive and cohesive services included physical security operations, Emergency Response Teams (ERT), personnel security, badging, 911 dispatch center, fire and rescue, fire prevention and fire protection engineering, aircraft rescue and firefighting (ARFF), advance life support (ALS) ambulance services and emergency management, as well as management of the NASA Protective Services Training Academy (NPSTA) providing federal law enforcement training for all NASA Centers.

Space Exploration Technologies Corp.

Space Exploration Technologies Corp. (SpaceX) provides launch services in support of NASA's Launch Services Program. SpaceX provides launch services to NASA using the Falcon 9 vehicle under the NASA Launch Services II multiple-award, indefinite delivery/indefinite quantity task order contract. The Falcon 9 launches from CCAFS and VAFB. SpaceX also supports NASA's goal to foster activity leading to the development of orbital commercial Crew Transportation Systems. Under a funded Space Act Agreement, SpaceX is developing an integrated launch abort system design for the Dragon spacecraft and evaluating crew accommodations.

AI Solutions Inc.

The Expendable Launch Vehicle Integrated Services 2 (ELVIS 2) contract was responsible for performing and integrating the overall programmatic ELV business and administrative functions, including program and project planning, risk management, and evaluation and information technology. Services provided include the management, operation, maintenance and sustaining engineering of NASA's ELV communications and telemetry stations located at CCAFS and VAFB. AI Solutions Inc. also provided engineering services and studies, and technical services for various ground and flight ELV systems, missions and payloads. ✨

Your Procurement Dollars at Work Geographical Distribution by State (Fiscal Year 2013 Obligations)

STATE	TOTAL DOLLARS
ALABAMA	13,749,266
ARIZONA	236,894
CALIFORNIA	37,751,485
COLORADO	305,283,260
CONNECTICUT	5,550,382
DISTRICT OF COLUMBIA	65,440
FLORIDA	145,451,742
GEORGIA	8,074,059
ILLINOIS	149,770
INDIANA	466,800
KENTUCKY	993,104
LOUISIANA	5,468,206
MARYLAND	211,935,546
MASSACHUSETTS	421,419
MICHIGAN	65,222
MINNESOTA	259,744
MISSOURI	179,705
NEBRASKA	28,768
NEVADA	252,863

STATE	TOTAL DOLLARS
NEW HAMPSHIRE	436,229
NEW JERSEY	1,061,036
NEW MEXICO	193,252
NEW YORK	1,296,382
NORTH CAROLINA	2,271,676
NORTH DAKOTA	19,878
OHIO	1,370,509
OKLAHOMA	5,984,938
OREGON	185,289
PENNSYLVANIA	7,825,037
RHODE ISLAND	158,900
SOUTH CAROLINA	78,600
SOUTH DAKOTA	18,887
TENNESSEE	63,623,243
TEXAS	22,809,148
UTAH	36,301
VIRGINIA	225,049,587
WASHINGTON	378,207
WISCONSIN	4,360,850
TOTAL	\$1,073,541,624

Top 25 KSC Business Contractors for FY 2013

Contractor	Dollars
UNITED LAUNCH SERVICES LLC	295,542,533
QINETIQ NORTH AMERICA INC.	145,047,387
URS FEDERAL TECHNICAL SERVICES INC.	114,284,302
ABACUS TECHNOLOGY CORP.	66,718,044
JACOBS TECHNOLOGY CORP.	61,514,809
CHENEGA SECURITY & SUPPORT SOLUTIONS LLC	31,647,610
SPACE EXPLORATION TECHNOLOGIES CORP.	31,305,888
AI SOLUTIONS INC.	27,637,449
J.P. DONOVAN CONSTRUCTION INC.	20,977,790
INOMEDIC HEALTH APPLICATIONS INC.	19,483,572
SAUER INC.	18,565,069
IVEY'S CONSTRUCTION	16,255,866
SCIENCE APPLICATIONS INTERNATIONAL CORP.	14,218,563
A-P-T RESEARCH INC.	12,172,793
AIR LIQUIDE LARGE INDUSTRIES U.S. LP	11,608,939
BOEING COMPANY	8,100,000
SIERRA NEVADA CORP.	8,100,000
RUSH CONSTRUCTION INC.	7,365,847
CAPE DESIGN ENGINEERING CO.	7,342,977
ASTROTECH SPACE OPERATIONS INC.	7,215,490
CANAVERAL CONSTRUCTION CO. INC.	7,146,107
MCDONNELL DOUGLAS CORP.	6,689,381
REYNOLDS SMITH AND HILLS INC.	6,218,602
WICHITA TRIBAL ENTERPRISES LLC	5,941,600
TOTAL	\$951,100,618

National Aeronautics and Space Administration

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